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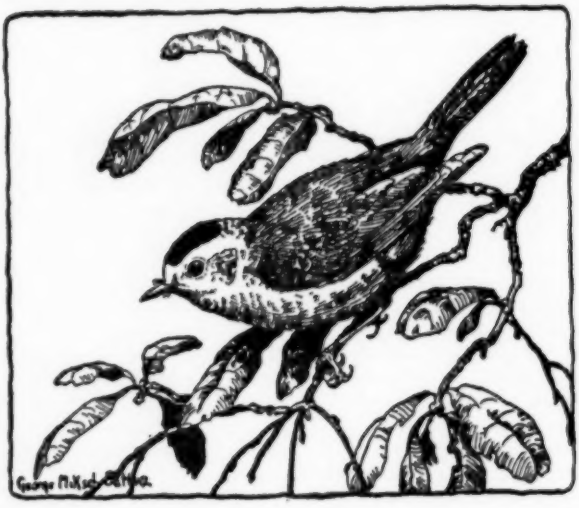

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LINEATED WOODPECKER

(Dryocopus lineatus)

Adult female, life-size. Painted in the field from a specimen collected February 17, 1938, along the Río Corona, near the village of Güemes, Tamaulipas, México, by George Miksch Sutton. This is the seventh of a series of color plates honoring the memory of Dr. David Clark Hilton.

THE LINEATED WOODPECKER

BY RICHARD R. GRABER

Essentially a bird of tropical lowlands, the Lineated Woodpecker (*Dryocopus lineatus*) also occurs as high as 5000 feet in Mexico and 3600 feet in El Salvador. In Tamaulipas and San Luis Potosi, I have seen it in scrubby growth, but fairly mature forest seems to be the favored habitat. It will be interesting to see how this species survives increasing deforestation in Mexico. Fortunately it has a broad range, from southeastern Sonora and southern Tamaulipas, Mexico, to northern Argentina.

Over this range it varies considerably in size, plumage, and color of soft parts. Bill and eye color also vary with age. Dickey and van Rossem (1938. *Zool. Ser. Field Mus. Nat. Hist.*, 28:311) noted the bill of a juvenile from El Salvador as "bluish-horn color, tip paler," and of adults as "ivory-white becoming bluish at the base of the maxilla and on basal third of mandible." The iris of the juvenile was "dark brown," and of adults "bluish white." A similar change in eye-color with age occurs in the Pileated Woodpecker (*Dryocopus pileatus*). In northern Argentina, Wetmore (1926. *U.S. Natl. Mus. Bull.*, 133: 216) found the bill of an adult male Lineated Woodpecker to be "pale smoke gray" and the iris "dull white." Sexual dimorphism in this species also resembles that in the Pileated Woodpecker, males having the 'mustache' marks and entire crown red.

The loud, high pitched cries of Lineated Woodpeckers in Mexico are reminiscent of the Pileated. However the birds must be versatile vocally, since Wetmore (1943. *Proc. U.S. Natl. Mus.*, 93:272) "heard them uttering a chattering call that was not unlike that of a *Centurus*, while the drum was a loudly resounding, rapid roll, slowing slightly toward the end."

Dickey and van Rossem (*op. cit.*, 309) stated that pairs of the Lineated Woodpecker stay together throughout the year, and showed that the species bred in mid-winter in El Salvador. To the north, breeding occurs in, or at least extends to, April and May (see Sutton, Lea, and Edwards, 1950. *Bird-Banding*, 21:48–49; and Wetmore, 1943. *Proc. U.S. Natl. Mus.*, 93:272). This is further indicated by a Veracruz specimen in the Sutton Collection which was in postjuvenal molt on July 20. Dickey and van Rossem (*op. cit.*, 310–311) wrote, however, that the annual and postjuvenal molts may occupy three months or more. Juveniles are similar to adults. In the Veracruz specimen at hand, the outermost primary is conspicuously larger than in several adults, and the character may be good for aging specimens if it proves to correlate with dark eye and bill-color and buffy-tipped primaries. This reaffirms the point that collectors should be *especially* conscientious in noting colors of the fleshy parts.

Department of Zoology, University of Oklahoma, Norman, Oklahoma, April 21, 1954

THE OIL GLAND OF BIRDS

BY WILLIAM H. ELDER[1]

THE uropygial gland of birds, otherwise known as the oil gland, preen gland or rump gland has been the subject of much discussion and investigation for more than 100 years. The literature dealing with this subject is widely scattered in many journals and in many languages. The best review was written by Hou (1928b) in *The Chinese Journal of Physiology*—a journal available in few libraries in this country. Recent papers indicate that many authors are unaware of this diverse literature. This paper was prepared to draw together the early work, review Hou's papers, summarize the work that has appeared since, and present the results of recent experiments at the Delta Waterfowl Research Station.

EARLY OBSERVATIONS

Emperor Frederick II, in his monumental thirteenth century treatise on falconry (Wood and Fyfe, 1943:71), was seemingly the first to discuss the function of the oil gland of birds. He believed that its product not only oiled the plumage but also provided a poison which was introduced by the claws of hawks and owls thus bringing quicker death to their prey. In 1678 Willughby studied the question of the toxic nature of the oil gland secretion but found no evidence to support Frederick's contention.

The next mention of this gland was by Tyson in 1683. In his "Anatomy of the Mexico Musk-Hog" he pointed out the similar position of the scent gland in the musk-hog (=collared peccary, *Pecari angulatus*) and the uropygial gland in the partridge, and suggested that they were perhaps analogous. The possibility that this gland may serve a function in providing scent remains a moot question even today.

The chief reference to this gland during the next century seems to have been by the famed anatomist Cuvier in 1799 (Dallas, 1867:38–42), who provided the first description of the internal structure of the gland. He believed that it was a closed secreting vesicle but perhaps he examined a dove in which the gland is undeveloped and ductless for later workers have been able to trace and describe the ducts and, hence, it usually has not been considered an endocrine gland. From his study of the Gray Linnet (*Carduelis cannabina*), Monterosso (1915) believed it to function alternately as an endocrine gland and as a gland of external secretion; but details of his morphological studies alone seem to have reached publication.

1. Contribution from the Delta Waterfowl Research Station, Delta, Manitoba, and the Missouri Cooperative Wildlife Research Unit: U.S. Fish and Wildlife Service, Wildlife Management Institute, Missouri Conservation Commission, Edward K. Love Foundation, and University of Missouri cooperating.

Anatomy

During the nineteenth century and early in the twentieth there appeared a considerable number of thorough papers dealing with the anatomy of the oil gland, both gross and microscopic. Outstanding among those treating of the gross anatomy were Nitzsch (translation by Dallas, 1867), Owen (1866:230), Kossmann (1871), Paris (1910–13), and Granvik (1913).

The work of these men has shown that the uropygial glands are embedded beneath the skin in a mass of fatty tissue just dorsal to the levator muscle of the tail. The shape varies greatly among species and has considerable taxonomic significance (Coues, 1903:89). In various species the glands have from one to five openings (2–8, according to Grassé, 1950:285–289), to the outside through a nipple-like structure which is often covered by a tuft of specialized feathers. This tuft serves as a brush, functionally elongating the nipple and aiding in anointing the bill (Schumacher, 1919). At one time it was thought (Dallas, 1867) that the arrangement of these feather tufts was the best criterion for distinguishing some natural groups of birds both at the family and generic levels. The glands are best developed in aquatic birds. However, Burton (1822) pointed out that the oil gland is very small in Man-o'-war birds (*Fregata aquila*); when birds of this species were shot their plumage soaked quickly when they dropped into the sea. Gurney (1913:538–539) stated that the gland of the Gannet (*Sula bassana*) is the largest proportionally of all birds but is not used for lubrication of the feathers. Among parrots and doves are found all degrees of development of the gland from species with none to those with fully functional glands (Garrod, 1874a and b). It is absent in struthioniform, rheiform, and casuariiform birds and in some species of several other orders (Galliformes, Gruiformes, Caprimulgiformes, Apodiformes).

The gland is surrounded by a connective tissue capsule apparently devoid of muscle fibers (although Gadow, 1891:488, believed it to have a layer of smooth muscle) and receives its blood supply from the caudal artery; it is drained by the caudal vein which runs between the caudo-spinal muscle and the levator muscle. The nerve supply is from the first pair of caudo-spinal nerves plus additional sympathetic fibers. Kossmann (1871) electrically stimulated the nerve to one lobe of the gland and caused unilateral vasodilation of the artery to that lobe and a simultaneous flow of secretion from that lobe. Ligation of this artery stopped the flow. Paris (1906–13) confirmed these findings and added that the sympathetic nerve fibers must cause relaxation of the sphincter muscle around the external opening of the duct of the gland. This suggests many similarities to the sebaceous glands of mammals.

Histology and Embryology

The outstanding papers dealing with this aspect of the subject are those in

German (Kossmann, 1871; Granvik, 1913; Esther, 1938), French (Pilliet, 1889; Paris, 1912a and b), and Italian (Orlandi, 1902; Lunghetti, 1902–07; Monterosso, 1915). It is mainly from their works that the following summary has been drawn.

In the chick the gland appears first on the 9th to 10th days of incubation as a hollow invagination of the cutaneous epithelium in the rump region. Each lobe of the gland comes to have a stratified epithelium continuous with that of the duct of that lobe. Fat first appears in the gland cells on the 17th day of incubation (Ida, 1931).

The highly developed trabeculae of the inside of the gland resemble those of the heart of mammals and are packed with tiny parallel secretory tubules which produce their product by the gradual breakdown and sloughing of entire cells (a holocrine secretion, Biedermann, 1930; Grassé, 1950). The cell walls soon break down but leave the golgi apparatus intact in the secretion as revealed by special golgi stains (Bowen, 1926). Other cytological details and a discussion of the role of the mitochondria, golgi, and nucleus may be found in the work of de Jonge (1879), Röhmann (1902-04), Bowen (1926), and Hsu (1935, 1936). The weak reaction of the gland's secretion to osmic stains shows that there is little fat present in the product. This conclusion fits well with the histo-chemical work performed by Stern (1905a, 1905b). She concluded that the secretory, scarlet-red staining granules were present in the periphery of the tubules along with mitotic figures but increased in size toward the lumen while lipoid granules with osmic acid affinity were scarcer toward the lumen and the fine fat granules were found throughout.

Smooth muscle fibers are found around each trabecula of the gland and also form a sphincter at the nipple of the excretory duct. It is probable that these muscles relax under the stimulus of the sympathetic nerve fibers, thus causing the gland to empty. Relaxation seems to be induced by contact of the bird's bill with the nipple of the gland, where the receptors of pressure sensation, the Corpuscles of Herbst, are clustered (Paris, 1912b; Schmidt, 1924).

Phylogeny and Homology

Students of comparative histology have been concerned with the probable homologies of the uropygial glands and have likened them to lizard skin or scent glands (Paris, 1913; Van Eggeling, 1931; Schmidt, 1924; Esther, 1938; to crocodile cloacal glands (Esther, 1938); to turtle tear glands and snake poison glands (Orlandi, 1902; Pilliet, 1889). However, Maurer (1895) saw no relationship to reptilian glands.

Many investigators have noted the similarity in structure of the uropygial glands of birds and the sebaceous glands of mammals (Kossmann, 1871; Furbringer, 1888; Joseph, 1891; Pilliet, 1889; Orlandi, 1902; Wigger, 1906; Paris, 1913; Biedermann, 1930). Kossmann (1871), Paris (1913), Pycraft

1910:15) believed that they serve the same function—that of true scent glands. In the sporting literature of that time it was frequently claimed that retrievers were able to find diving, crippled ducks by following the odor of the oil they left behind, and Herter (1929) maintained that leeches find their duck hosts in the same manner. It was suggested (Dallas, 1867) that the glands may serve as a repellent organ in such species as the Hoopoe (*Upupa epops*), for, in the incubating female, the secretion collects, turns black and gives off a powerful odor which persists as long as the young are in the nest. Ghidini (1906) and Coupin (1914) claim that the defense function of the gland in the nestlings of this species is extremely effective for the young store up the secretion until the nest is visited by some rodent or weasel whereupon they discharge the fetid fluid onto the intruder. A similar function is described by Hingston (1933) in the Great Hornbill (*Buceros bicornis*) where the yellow threat sites—the bill casque, neck, crown, rump and wing angles—receive their color from the oil of the uropygial gland.

The absence of uropygial glands in ratite birds led Beddard (1898:18–19) to conclude that glandlessness was a primitive character but Pycraft (1910:15) pointed out that anlagen of the glands were present in the embryo of some ratites and that the loss of the glands in the adult could be considered a secondary specialization rather than a primitive character.

Genetics

The inheritance of glandlessness in doves was investigated by Johansson (1927) who found the condition to be recessive and frequent in the Fantail breed; it was not correlated with the number of tail feathers. Seven of 1,360 ordinary doves lacked the gland, which undobutedly explains the disagreement between Darwin and Kossmann (Kossmann, 1871). More recently Kessel (1945) has reported on the inheritance of uropygial gland papillae in domestic fowl.

Chemistry

Hou (1928b) states that the first analysis of the excretory product was made by Chevreul in 1853, who concluded that the sebaceous substance was developed by the setting free of a volatile acid in the presence of water. (This reference I have not been able to confirm for Hou's citation is in error). But a complete chemical investigation was not made until 1879, when de Jonge, in about two grams of the oil from a goose, found the following substances present: casein, albumin, nuclein, lecithin, low and high fatty acid, and a non-saponifiable portion, which he believed to be cetyl alcohol. Potassium, sodium, calcium, magnesium, and chlorine were found in combined form along with free sebacic acid and traces of sodium and potassium soaps. Newton (1893–96:653–654) reported that analysis of the secretion showed it possessed no sugar.

Röhmann (1904a) carefully repeated the chemical analysis and concluded that the secretion had only a small portion of fat (triglyceride of fatty acids) but a larger portion of fatty acid, ester of octadecylalcohol, and a chloroform-soluble body. Ida (1931) confirmed these findings. Röhmann (1902, 1904a) further pointed out that the gland must convert fat into fatty acids and then to wax—a hydrogenation through enzymatic action. He and de Jonge (1879) agreed that in 100 parts of the solid secretion approximately 60 are soluble in ether. The ether extract is a clear oil of yellow color which separates out as a nearly neutral, solid substance upon standing. It has an index of acidity of 0.75 to 3.4. The saponification index and iodine number are much less than for ordinary fat.

Although these early workers did not find cholesterol or the ester of cholesterol in the gland secretion of geese, Hou (1928b, 1930a) reported finding cholesterol in the glands and on the feathers of chickens. Ida (1931) found cholesterol in the whole gland but not in the secretion of the 17 species he studied. An earlier Japanese worker (Yamaguchi) whom Ida cites believed the gland excreted superfluous cholesterol.

In order to determine whether the uropygial glands actually synthesize the oil they secrete or merely convert dietary fats, Plato (1902) and Röhmann (1904a) fed geese on a diet of fat-free uncooked barley plus sesame oil and tested for the presence of the oil in the secretion of the uropygial gland at frequent intervals, determining that eight to 18 days are necessary for the transfer. However, it is not surprising that such an oil would appear in various fat depots of the body when the diet was overloaded with a foreign oil. More conclusive work was performed by Paris (1913) by feeding Sudan III in olive oil to ducks for several months. On autopsy peritoneal and body fats were stained orange but the oil of the gland was not. More controlled work was performed by Stern (1905a) by means of histochemical techniques in which she demonstrated that the outer zone of cells in the stratified epithelium actually contained fat droplets that were synthesized within the gland. Ida (1931) confirmed, in general, Stern's findings concerning the distribution of fat within the gland.

Function—Anecdotes and General Observations

In 1832 there began a prolonged argument over the supposed functions of the gland. This controversy raged in the pages of the *Magazine of Natural History* and was characterized by more heat than light. With much spirit and invective Waterton (1832, 1836, 1860) contended that birds' beaks were improperly shaped for such a purpose as dressing the feathers, that the feathers of the head and neck were as shiny as those of the body although not "preened" by the beak—"proof positive that the plumage of the bird has not

been lubricated with oil from the tail gland." He maintained that the sole function of the preening activities was removal of lice—which he claimed to have found in quantities in the gullets of birds he had skinned.

The Rev. Morris (1836) poked holes in Waterton's arguments and reported watching birds anoint their bills and crown feathers at the feather tuft on the oil gland. This was confirmed for ducks and pelicans by Crisp (1860), and Hussey (1860) gave a careful and cautious description of ducks' use of the bill in oiling their feathers. In the next year Matthews (1861) gave a convincing and detailed account of chickens observed at a distance of two feet immediately after a rain. The birds raised the feathers of the gland region, turned the head to one side, and squeezed the oil from the gland with their beak before wiping it off with the head and neck, which were in turn used to anoint the body plumage. This opinion was followed by Coues in the first and subsequent editions of his "Key to North American Birds" (1903:89).

Although Newton in his famous "A Dictionary of Birds" (1893:654) followed Coues' opinion, Pycraft (1910:15) sharply disagreed and suggested that, as in mammals, this gland served as a scent gland.

In 1910 Stubbs coined the term "feather-film" to describe the pile of cilia and barbules which keeps the surface film unbroken around the bird's plumage. He believed that the oil from the preen gland must play but a minor part for duck feathers which he washed in warm soda water and benzine retained their buoyant properties.

Here the sleeping dog lay until rudely awakened in 1929 by Eugene Law, who, upon reading the old controversy and little of the research of the intervening 70 years, made a valiant appeal for Waterton's case. Based on kitchen-table-type experiments he (1929) concluded that feathers carry no oil and that the sole function of the gland is to lubricate the beak (which is then polished on the feathers!).

The cudgels were again taken up by Madsen (1941), seemingly also unaware of the literature, who reiterated Law's contentions and cited his own simple experiments to show that ducks' feathers are waterproof strictly because their physical structure provides a hydrofuge mechanism. He believed that the tips of the belly feathers actually became wet so as to reduce friction in swimming!

Fabricius (1945) favors the opinion that the ability of the duck to keep its plumage dry is, at least in part, dependent upon the uropygial gland and that for normal functioning the diet of the downy young must include some substance provided by insects and crustaceans. However, thousands of normal ducklings have been reared at the Delta Research Station without these animals in their diet.

A similar role for the secretion of the oil gland and for powder down of birds has been suggested by Schüz (1927) and Esther (1938). Esther thought that powder in doves and other birds with powder down serves, in part, the same function as oil. Percy (1951:36–39) has provided photographic evidence of the concurrent use of powder and oil by the Bittern (*Botaurus stellaris*) and Heron (*Ardea cinerea*) after their plumage was contaminated by eel slime.

The early suggestion by Schauer (1877) that the gland had electrical properties was obviously a case of static electricity, discharged as his fingers touched the oil gland nipple in the dark of his laboratory.

Occlusions and Ablations

Stoppage, both naturally and experimentally, and surgical removal of the oil gland provide some insight into its function.

A seven-inch "horn" protruding from the side of the uropygial gland of a Lapwing (*Vanellus vanellus*) was reported by Ticehurst (1910). This showed that stoppage and continued formation of the secretion resulted in rupture of the capsule and continuous oozing of the secretion, which came to solidify and harden. Similar excrescences were induced by Hou (1928b) by experimental occlusion of the gland.

Stoppage in chickens, resulting in enlargement, was found by Bechstein in 1791 (Hou, 1928b) and Crisp (1860). The former reported that it caused a disease known in France as "darre" while Coupin (1914) refers to it as "bouton." This seemed to be an old wives' tale until 1939 when Mohey reported a similar disease in cage birds and urban-dwelling chickens in India. He describes native as well as his own veterinary procedures for treating the disease.

Total removal of the gland by surgical procedure was first performed in Germany by Kossmann (1871), who saw no change in his pigeons following this treatment. The following year (1872) Philipeaux removed the uropygial gland from a duck and reported that the plumage remained normal, but the plumage of Hou's ducks (1928b) became dry and disorderly. Although these conflicting results perhaps are attributable to the small samples or poor operative technique, Philipeaux believed that when the ablation was performed on young ducks the gland was replaced by supplementary secretion in other skin glands in the region. But no one has found these "other skin glands." Joseph (1891) removed the glands from a few ducks and, after healing was complete, submerged them in water along with normal ducks. After a fifteen minute drying-off period the glandless birds retained in their plumage twice as much water by weight as did the normal birds.

The Italian histologist Lunghetti (1906) next performed ablations on a few 3-month-old chicks without apparent change.

Paris (1913) reported on the detailed structure of the uropygial glands of 350 different species of birds. His morphological work was accompanied by a few exploratory experiments. He ablated the glands in 10 birds (of 5 species) and saw no plumage changes. However, his birds were shunned by the controls. Coupin (1914) suggested that this might be due to their loss of normal body odor but a more convincing suggestion is that they might have been stealing some oil from the normal birds. This was actually seen by Hou (1928a, 1928b) when he ablated the glands in 16 pigeons, four chickens, four ducks and one goose. He then isolated the glandless birds from the controls and noted the following results:

1. By the fourth week, dulling and roughening of the plumage was seen with considerable soiling and very slow drying after bathing (ducks only?).
2. Heat loss, as shown by rectal temperatures before and after swimming in cold water, was greater in glandless birds than in controls.
3. Microscopic oil droplets normally present in great numbers on the barbs, barbules, and barbicels were progressively lost and completely disappeared by the third month, indicating that a bird normally removes oil as well as spreads it during preening and that in the absence of a new supply it eventually is entirely lost.
4. A slow, progressive decrease in body weight was noted, starting between 40 and 100 days after ablation of the oil glands.

Ida (1931) ablated the glands of ducks, chickens, and geese, finding no general changes in the plumage or appearance even when four months had elapsed. However, egg laying ceased.

Esther (1938) agrees with Paris and Ida in finding no general changes following gland ablation in his birds, which paired, bred, and reared several broods successfully when both sexes were made glandless. At the Delta Station one of the mallard hens, glandless for nearly a year, reared a brood successfully.

Feather Studies

Although Law (1929) made crude attempts to show that there was no oil on bird feathers and Madsen (1941) showed that feathers were wettable with colored dyes, the only thorough work reported has been that of Hou (1928b). He took small bundles of feathers from control birds and birds from which the glands had been removed and, after drying these for 24 hours in a calcium chloride desiccator, subjected them to continuous fat extraction in an alcohol-

chloroform mixture in a Soxlet's apparatus for 24 hours. The bundles were then removed, air dried, then desiccator dried and weighed. Those from control birds lost approximately 5 per cent in weight, while the feathers from glandless birds gained approximately 2 per cent. Although the weight gain remains unexplained, the substance removed from the feathers of control birds was, at least in part, cholesterol as shown by the Liebermann Burchard test. Cholesterol both from the feathers and the oil glands was further identified by spectrographic analysis.

Desiccator-dried feathers suspended in a saturated atmosphere gained moisture for 48 hours, and feathers from a saturated atmosphere lost weight in a dry atmosphere for 48 hours. This indicated that feathers are permeable to water. It was further shown that normal feathers subjected to an aqueous solution of methylene blue for an hour and then washed for two hours showed dye in the interior of the barbules.

Microscopic examination of feathers removed from birds several months after their glands had been ablated indicated that their loss of color and gloss was due to actual physical breakdown, undoubtedly in part the result of the preening activity itself. Seemingly, loss of the oil predisposed the feather to physical degeneration, making its wear more rapid, until it was possible to see, by microscopic examination, that there were actual holes in the feather due to breaking off of bits of the barbs.

It is of interest to note Hou's (1928b) observation that, after the feather is drawn through the blades of the beak, an act of swallowing invariably follows, indicating 1) that there is an automatic, instinctive behavior pattern, or 2) that something has actually been ingested. This might well be dirt, dandruff, lice, and oil. R. C. Murphy (1936:473–474) suggests that the stomach oil of procellariiform birds may be the secretion of the preen gland subsequently swallowed to be later regurgitated and used as a feather dressing. Fisher (1952:390–391) states that stomach oil is used in preening but clearly shows that this oil is produced in the proventriculus and not in the uropygial glands.

Nutrition Studies

Hou (1928b) cites evidence that carnivores in zoos frequently develop rickets and may succumb on a diet of horse meat alone, while addition of intact birds or rabbits plus liver, fat, and flat bones prevents this. Rowan noted (1928) that his Merlins (*Falco columbarius*) needed feathers in their diet in order to remain healthy and that the mother forcibly fed these to her young every few days. Rowan suggested that the feathers might contain vitamin D resulting from irradiation by sunlight of oil spread on them from the preen gland.

A thorough study of the nutritional function of the preen gland product was reported in a series of papers by Hou (1928a, 1928b, 1929, 1930a, 1930b, 1931). A weak, rachitic pigeon in which the oil gland had been ablated was restored to health upon eating an irradiated gland from another bird. A second rachitic pigeon fed on a gland removed in the dark showed no improvement. Eight chicks (four of which were glandless) were placed on a rachitogenic diet until two died and all showed decalcification and swollen joints. Ultraviolet-light treatments which were then begun cured the controls of their rickets but not the glandless birds. The same results were obtained when the glands were removed in a group of four chicks after the rickets had developed —the controls again recovered under ultraviolet exposures but operated birds did not.

Adult pigeons, mallards, and chickens (kept in the sunshine after ablation of the glands) did not develop rickets but the plumage degeneration was severe. (The degenerative changes are never as severe in pigeons as they are in chickens and ducks.)

Guareschi's note (1934) suggesting a relationship between rickets, abnormal growth, and a keratinized uropygial gland in one chick and one pigeon added little to our knowledge.

Clark (1934) and Knowles, Hart, and Halpin (1935) removed the oil glands from three groups of Leghorn chicks at ten days of age. With nine birds in each group the first group was given a cod-liver oil supplement, the second ultraviolet treatments, and the third left on the rachitogenic base ration alone. Up to four weeks of age all gained weight like the normal unoperated controls but from this time on the third group developed rickets. Although they saw these results as a complete contradiction to Hou's work, it seems the conclusion should have been that rickets is easily prevented in the absence of the oil gland if therapy is started early, but, as Hou showed, once rickets has set in it is not readily cured by ultraviolet light. In brief, it is easier to prevent than to cure.

The last work of this sort reported was by E. F. Murphy (1936), who removed the oil glands and the combs from 50 Rhode Island Red chicks at the age of two weeks. One week later, along with an equal number of controls, they were put on a rachitogenic ration. The birds were treated as five groups, with ten glandless and ten intact birds in each group. There was a slight difference in the growth rates of the glandless and intact birds in the control group on basic ration alone, but apparently no significant difference in (1) the group receiving cod-liver oil supplement from the start, (2) the group given cod-liver oil starting with the fifth week, and (3) the group given 20 minutes daily irradiation after rachitic symptoms were apparent in the fifth week. But among the remaining group—those that received only five minutes of ultra-

violet irradiation from the start—the glandless birds were greatly retarded as compared with the intact birds. Analysis of the bones showed that in four of the five groups the intact birds had a slightly greater total ash content than did the glandless birds. Unaided by statistical analysis, Murphy concluded that there was no real difference in the responses of glandless and intact birds, but her data suggest to me that there may have been a real difference and that the thrift of glandless birds was much less than that of intact birds on a subminimal dose of ultraviolet light, although when given 20 minutes of treatment per day the thrift of glandless birds equalled that of intact birds.

This was shown earlier by Hou in his 1931 paper (again with too few birds) where he concluded that ultraviolet light cured rickets in chicks with or without oil glands when the legs and feet were exposed, quite regardless of whether the feathers were exposed or not. This later work was not in complete agreement with his first paper, and it seems clear that the threshold for ultraviolet therapy varies so much among species, and among breeds of one species, that consistent results cannot be expected when the irradiation is not measured and expressed in terms of actual dosage, as in the work of Maughan and Dye (1929).

Although we are forced to conclude that, at least in chickens, the presence of the preen gland is not essential for the prevention of rickets, it has not been shown that the gland does not play an important role. In another paper Hou (1930a) demonstrated that feathers contain vitamin D, that it can be extracted with fat solvents, and that the cholesterol content is twice as great in the feathers of intact birds as it is in feathers of glandless birds.

Hou tested thoroughly, by means of published roentgenograms taken at the start and at the end of the experiment, the effects of feeding feathers, feather extracts, and other parts of birds both normal and rachitic, to rats kept on a rachitogenic diet. The results are shown in Table 1.

TABLE 1

EFFECT OF FEEDING CHICKEN TISSUES TO RATS WITH RICKETS

Rachitogenic diet supplement	Per cent healing of rickets in rats fed on tissues from chickens	
	Normal	*Glandless*
Chicken feathers	70%	10%
Ether soluble extract of feathers	93%	0%
Skin	96%	38%
Body fat and muscle	90%	0%

This seems to be conclusive evidence that the oil on feathers of normal chickens contains an appreciable amount of vitamin D which could serve as a dietary supplement if accidentally ingested during preening. However, Ida (1931) found no cholesterol in the preen gland secretion, and Koch and Koch (1941) found no pro-vitamin D in alcohol-ether extracts of preen glands or feathers of ten-week old pullets when assayed on rats. The same procedures demonstrated that extracts from skin and legs of the pullets did cure rickets in rats.

Some of the seeming contradictions in these experimental results may be due to the difference in age of the birds from which feathers were clipped for chemical extraction and tests for vitamin D. Hou (1930a) pointed out the significant difference in the ability of young and adult chickens to store anti-rachitic factor. Adult birds kept in the dark on a rachitic diet for four months after the oil glands were removed retained in their skin and fat appreciable amounts of anti-rachitic factor, while young kept in the sunlight for four months following ablation of their glands completely lost this factor.

Relationship of Oil Gland to Endocrine Glands

Ida (1931) found that not only were no more eggs layed by the ducks, geese, and chickens from which he had removed the uropygial glands but that from 146 to 204 days after operation there was complete atrophy of the gonads in both sexes. This has not been found by any of the later workers.

Esther (1938) suggested that the uropygial glands of doves had some endocrine relationship for he found that the inner epithelial lining of the gland developed rapidly in nestlings after hatching but atrophied as soon as the young no longer received pigeon milk. A much earlier suggestion was made by MacGillivray (1837:44–45) that the function of the gland was related to the molting process for he found it highly developed during molt and greatly diminished after the molt was complete. This lead seems never to have been investigated further. Grassé (1950:285–289) states that the gland seems better developed in the male than in the female and that in the goose it reaches maximum size in January and February.

That the size and amount of secretion of the uropygial glands is under the influence of sex hormones was first suggested by Selye (1943) when he stated categorically: "It is known that during the mating season it [the uropygial gland] produces an increased amount of secretion at least in certain species." He injected Leghorn chicks, starting on the second day of life, with various steroid hormones, and found that testoid hormones depressed the uropygial glands between the 20th and 45th days but that the glands then resumed normal size and histology in spite of continued hormone treatment.

Kar (1947) found that the uropygial glands of Leghorn cockerels atrophied as a result of castration in 86 days from an average weight of 604 mg. to that of 345 mg. This atrophy was prevented by injections of the male hormone, testosterone. The same male hormone depressed the weights of uropygial glands in normal chicks but female hormone (diethylstilbesterol) did not. In old capons (age 156 days) the gland had returned to normal size without hormone injections, probably due to male hormone supplied by hypertrophy of adrenal cortical tissue.

These findings all suggest that the amount of uropygial gland secretion is under the influence of male sex hormone.

Experiments at Delta, Manitoba

Preliminary experiments concerning the function of the uropygial glands of ducks were made at the Delta Waterfowl Research Station at Delta, Manitoba, in the summer of 1947. Glands were surgically removed from 5 Redhead (*Aythya americana*) and 5 Shoveller (*Spatula clypeata*) ducklings less than ten days of age. All were kept in the hatchery where healing was observed to be prompt. The ducklings were normal in appearance and behavior until the juvenal plumage was assumed in August. The rough and dull look of the feathers was apparent at the time the birds were released on a large outdoor pond. They seemed to swim and dive normally but quickly became wet and bedraggled. Survivors were kept over winter in the hatchery but did not do well—their soiled, dry, roughened plumage was definitely inferior to that of normal ducks kept with them.

Early in July, 1951, glands were removed from 9 Mallards (*Anas platyrhynchos*) and 23 Redheads in order to study growth and survival in comparison with controls of the same age. Observations were also made of behavior and plumage changes induced by ablation of the glands. Because Hou (1928a, 1928b) saw evidence of glandless birds attempting to steal oil from normal birds, our controls were kept in separate pens from the operated birds without glands.

Preening Behavior. In the Redhead ducklings the preening behavior pattern was observed repeatedly both in glandless and intact birds. No alteration in the act either in sequence or frequency of occurrence could be detected in the birds deprived of their oil glands. They were seemingly unaware of the futility of their movements; the whole behavior pattern is probably innate, although it becomes more elaborate as the number of feathers to be preened increases with age.

Although the details are difficult to observe, the sequence of events is usually as follows: The tip of the bill is touched to the area of the gland's

nipple. Slight nuzzling movements suggest that the tactile-sensitive Corpuscles of Herbst are being stimulated. It is possible that the nipple is actually squeezed between the mandibles but this could not be observed for certain. (Manual manipulation by the observer did not elicit flow of the gland's secretion.) Apparently the stimulation from the duck's bill induces flow of the gland's secretion and immediately afterward the lower mandible, chin, sides of head, and occasionally the top of the head are wiped across the nipple. The lower mandible is then rubbed over the breast and belly feathers. Some feather arrangement may be accomplished at the same time. Use of the bill in preening feathers in other regions seems to be primarily a matter of feather arrangement and is usually accomplished without prior application to the oil gland.

The remainder of the body plumage, namely the flanks, back, and scapulars, is treated by being rubbed with the sides of the head and chin. The flight feathers are rarely touched with the bill but may receive oil when the sides of the head are rubbed along the sides of the body.

The pattern of the preening behavior is usually as described above although the sequence of events may vary. Frequent preening was observed during which, and prior to which, no use was made of the oil gland. Such feather arranging is probably much more frequent than is preening following use of the oil gland. The complete preening pattern, including the movements attributed to anointing the head and bill in the normal birds, was observed in both intact and glandless ducklings up to the age of seven weeks, when the summer's study period ended. The preening pattern is seemingly innate for it persisted in these glandless ducks and was repeatedly seen during the following summer after the birds were fully adult.

Most of the same preening behavior described for the Redhead was also seen in Mallards although the condition of their housing made them difficult to observe.

At the age of five weeks one of the groups of glandless Redheads was placed in the same pen with a group of normal ducklings in order to watch their reactions to each other. At no time during the ensuing two weeks were glandless birds seen to attempt to steal oil from their intact companions as was described by Hou (1928b), nor was stealing seen the following summer when the ducks were adult.

Plumage Comparison and Behavior toward Water. The difference in appearance between glandless and normal ducks, especially in the Redheads, was striking. The feathers of normal birds were glossy and kept well arranged while those of glandless birds were dry, lusterless, and matted (see Figs. 1 and 2). The difference was even more apparent when the birds emerged from water; feathers of the normal ducks remained dry, glossy and in place, while

those of the glandless ducks became completely water soaked, matted, and disarranged.

Although there was some variation in the behavior of different pens of Redheads under observation so far as their use of water was concerned, it was obvious that glandless birds avoided water even to the extent of being cautious

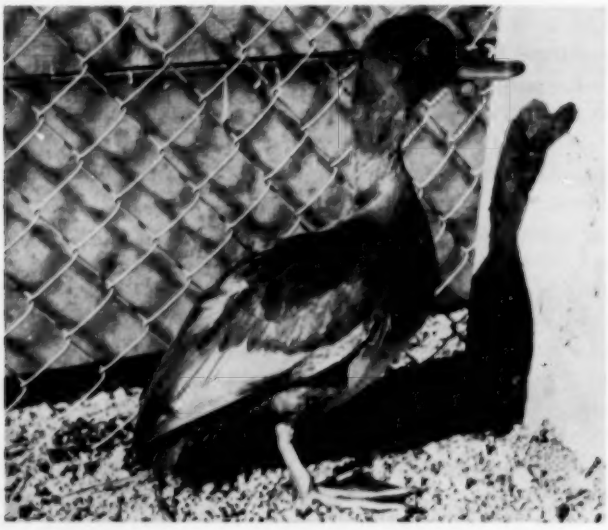

FIG. 1. Normal, hatchery-reared Redhead, age approximately 15 weeks.

about slipping down the incline of the pens during feeding. In contrast, the normal Redheads, by seven weeks of age, spent much of their time on the water—feeding, playing, and preening—and even rested on the water at night. The difference in the condition of the plumage in normal and glandless birds seems to be an obvious explanation for the disparity in amount of use made of water by the two groups.

Differences in plumage of intact and glandless birds disappeared with the completion of the molt the following summer. The glandless birds were not only restored in appearance but also in behavior for they no longer avoided the water but swam and bathed with other ducks on the pond. The glandless ducks had to be caught and the leg band numbers read in order to distinguish them from normal birds. However, their plumage again showed deterioration during the ensuing winter and was again fully restored to normal by molt in the next summer (their third year of life). Madsen (1941) reports that one

adult duck from which the gland was removed just prior to molt was normal in appearance and behavior after the molt was completed. Heinroth (1928, 1:32–33) mentioned that sea ducks which have lost their water-proofness as a result of being shipped in a basket are restored to normal at the next molt, if they survive that long.

FIG. 2. Hatchery-reared Redhead, 15 weeks of age, from which oil gland was removed during first week of life.

Skin and Bill Condition. In the glandless ducks the surface of the bills, legs, and feet became dry; the bill peeled, the skin of the legs and feet thickened and cracked. This condition, especially of the legs and feet, was extreme by the following summer, after the glandless birds were more than one year old. It persisted after the birds were turned out on the enclosure pond and lived under natural conditions. Although the glandless birds' plumage was restored to normal after the eclipse molt, the skin condition did not improve. This reminds one of the suggestion first made by Trouessart (1906) that the oil gland was essential for oiling the skin as well as the feathers. In their third summer the glandless ducks at the Delta Station had completely normal plumage, bills, and legs after the molt.

Growth and Survival. In order to determine what effect removal of the oil glands might have on the growth of ducklings, both glandless and normal birds were weighed at frequent intervals. The average weights for each group

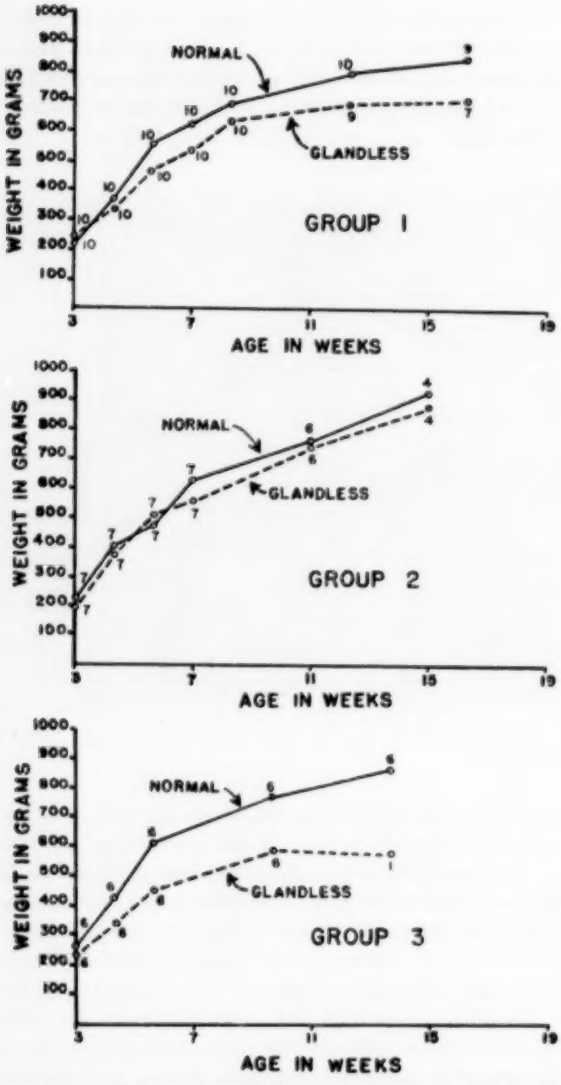

FIG. 3. Growth rates of 3 groups of Redheads in the Delta hatchery. The numbers of birds alive at each weighing are shown by the figure adjacent to each point on the curves.

of Redheads and Mallards throughout the summer growth period are shown in Figs. 3 and 4. It may be seen from examination of these figures that in

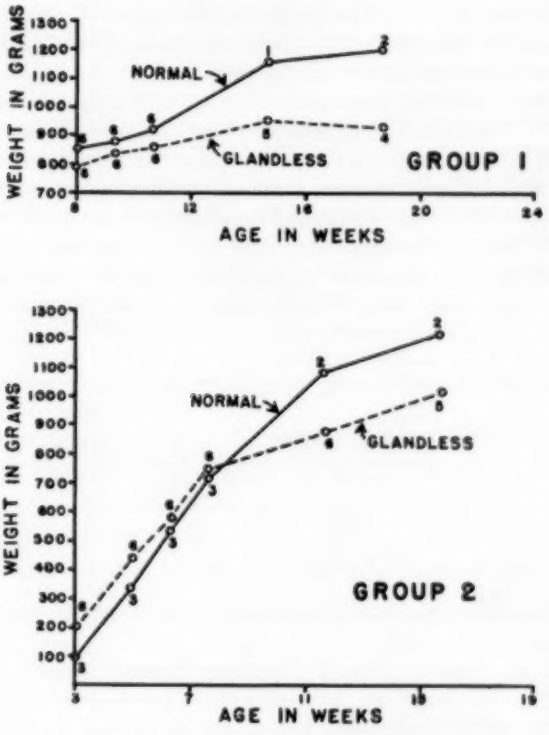

FIG. 4. Growth rates of 2 groups of Mallards in the Delta hatchery. The numbers of birds alive at each weighing are shown by the figure adjacent to each point on the curves.

each of the five groups of ducks the normal, intact birds showed a more rapid gain in body weight than did the corresponding group of birds from which the oil glands had been removed.

It seems certain that the oil gland is essential for maintenance of maximum thrift in ducks and that the differential growth rates shown by intact birds in captivity would be even greater in the wild. Although it is possible that the intact birds gained faster because of vitamin D supplement received through preening, it seems more likely that the difference in the two groups may be mainly attributed to the more efficient insulating layer provided by the feathers of the normal bird. The heat loss suffered by the glandless birds with matted plumage must be a constant drain depriving the birds of energy otherwise used for growth. It is doubtful that glandless ducks could long survive in the wild. Among the Mallards held in captivity, three of the 12 glandless birds

died by February but all of the normal birds were still alive. Among the Redheads 13 of the 23 normal birds died by February and 17 of the 22 glandless birds succumbed during the same period.

Species Differences in Size of Oil Gland in Proportion to Body Weight. Crisp in 1860 was first to show interest in the general relationship of preen gland weight to body weight and gave examples from several species. Because the size of the oil glands of water birds has frequently been pointed out as exceeding that of land birds, it might be anticipated that the glands of diving ducks would be larger in proportion to the body weight than would be those of dabbling ducks. As one test of this, all glands removed from young ducklings were weighed and compared with the weights of the birds from which the glands had come. The results were as follows:

Species	Number of birds	Per cent of body weight made up by oil glands
Redhead	24	0.54
Mallard	12	0.31
Shoveller	5	0.40

Glands from more species and from older birds would be required before correlations should be made.

Buoyancy and Wetting Time in Incubator-Hatched Ducklings Compared with Wild-Hatched Ducklings. Madsen (1941) claimed that in Eider duck nestlings (*Somateria mollissima*) the oil glands do not become functional until several days after hatching, but that these young have no difficulty remaining dry while swimming. It may be possible that young ducks are copiously anointed by their mother before leaving the nest (Heinroth, 1911) or that the downy young get enough oil from contact with their mother's feathers (Heinroth and Heinroth, 1928, 3:211–212) to make them water-repellent until their own glands become functional.

As one test of this hypothesis, four downy young of approximately three days of age were taken from a hen Redhead that chanced to pass the Delta Station with her brood. The behavior of these birds was studied in comparison with four downy young Redheads of the same size that had been hatched in the incubator. The birds were tested singly and as a group by placing them in washtubs half filled with ordinary water for 15-minute observation periods.

Wild-hatched ducklings seemed to float a little higher in the water, were more at ease, less active, never jumped in attempts to escape, and did not get wet. Incubator-hatched young began jumping to escape within 8 to 10 minutes

and showed more wetting of the outer belly down. The basic question remains unanswered: Did these ducklings jump to escape because they were getting wet or did they get wet because they were jumping?

A further test of the two groups of young was made the following day by placing each bird alone in a tub containing 25 liters of water to which had been added 50 grams of the wetting agent "Alconax." With wild-hatched Redheads jumping now began in ½ to 1 minute and within 3½ minutes all sank until only the head remained above the surface. Each was then quickly rescued, dried and later used for another trial on a later day. There was no progressive decrease in wetting time during the four trials as might have been expected had an oil film been removed by the concentrated solution of "Alconax." With the four incubator-hatched Redheads jumping began earlier and sinking to the level of the head occurred in half the time required by wild-hatched young. Again the cause of the earlier jumping could not be ascertained.

Application of a cigarette paper to the feather tuft on the oil gland of newly hatched ducklings from the incubator at the Delta Research Station always produced a greasy spot, indicating that the gland was functional in the first day of life in the Redhead, Canvasback (*Aythya valisineria*), and Mallard. This is in agreement with Esther (1938) who found the gland functional in the first day in domestic ducks and the Coot (*Fulica atra*). However, neither Madsen (1941) working with the Eider duck nor Veselovsky (1951) working with the Tufted Duck (*Aythya fuligula*) believed the gland to be functional in the first few days of life.

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Conclusions Concerning Function of the Oil Gland

From the welter of opinions, inconclusive observations, and contradictory experimental evidence reported in the literature, plus observations made at the Delta Waterfowl Research Station, the following general conclusions concerning the functions of the uropygial glands of birds seem justified.

1. The oil gland of birds secretes a substance containing much fatty acid plus some fat and wax. The act of preening induces, through a nervous re-

flex, flow of the secretion onto the nipple or feathers occurring at its opening. This substance is transferred to the body plumage and probably also to the wing plumage by the bill and head plumage.

2. In waterfowl the secretion of the oil gland maintains the water-repellent quality of feathers either directly or by preserving their physical structure.

3. In waterfowl the secretion is essential for maintenance of feather structure from one molt to the next. Without this secretion the feathers lose much of their normal function both as a flight mechanism and as a heat-insulating medium. It seems unlikely that a bird rendered glandless could survive in the wild.

4. Degenerative plumage changes following removal of the glands are more pronounced in waterfowl than in chickens and more pronounced in chickens than in pigeons. This seems reasonable in view of the general relationship of gland size and probable need for "waterproofing."

5. The degenerated plumage of Mallards and Redheads caused by removal of the glands when the birds were in the downy young stage is lost through normal molt during the following summer and the new plumage is normal in appearance, at least at first.

6. The secretion is used to anoint the bill and maintains its surface structure and glossy appearance; without the secretion the bill becomes dry and shows some sloughing. Neither the bill condition nor the dryness and cracking of the skin of the legs of glandless birds improves during the molt in the second summer of life but in the third summer their appearance is normal in every respect after the molt.

7. The rôle of the uropygial gland as a scent gland remains a complete enigma.

8. The uropygial gland is not essential for growth and development but in its absence growth is impaired in Mallard and Redhead ducks.

9. Hou's papers (1928–1931) seemed to show that the feathers of normal intact chickens (probably adult) contain vitamin D which is lacking in the feathers of glandless chickens and that these feathers have twice the cholesterol content of feathers from chickens having had their glands previously removed. These findings could not be confirmed by later workers (Koch and Koch, 1941) using pullets.

10. Although growth of glandless birds was slower than growth of intact Mallards and Redheads, the secretion of the gland can not be considered essential in the diet; however, if it is ingested in even small amounts following the act of preening, the vitamin D it is said to contain may significantly augment in the growing bird the usual dietary supply of that vitamin.

11. The preen gland is not essential for the maintenance of life in the laboratory; it certainly is essential for survival in the wild.

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A NESTING STUDY OF RED CROSSBILLS

BY DOROTHY E. SNYDER

DURING the winter of 1951–52, Red Crossbills (*Loxia curvirostra*) were seen at Eastern Point, Cape Ann, Essex County, Massachusetts, on numerous occasions. On March 2, Ludlow Griscom saw a female carrying nesting material at an estate called Shoal Waters; on March 4, I found the partially built nest.

Nests and eggs of this species have been previously seen and taken in New England; in Maine the most recent reports are those of Allan D. Cruickshank from the Muscongus Bay region, where a nest was found on August 22, 1949, and a nest with young on August 14, 1952 (letter). There is an old Massachusetts record of Maynard's (1882:520): "Nest and eggs collected in Tyngsboro a few years ago" (in August about 1875). An incubating female was flushed from a nest in Marblehead, Essex County, on April 22, 1917; the empty nest was brought a month later to William Brewster (1918). Red Crossbills were seen building a nest at Andrews Point, Cape Ann, in March, 1949 (Snyder, 1951). The female was incubating when the nest was blown down in a gale on April 6; the nest and egg fragments were recovered.

With the exception of Lawrence's observations (1949), I have found no complete record of the nesting of the species in North America; in most cases nests were deserted or broken up shortly after discovery. Therefore I decided to watch the Eastern Point nest from a distance unlikely to interfere with its success. Observations were usually made with a telescope from a car parked across the road. While this procedure prevented the gathering of precise data concerning egg laying, incubation, and number of days young were in the nest (facts previously determined for this species by Lawrence, 1949, and the Rosses, 1950), it did result in a series of observations during the entire period of a successful nesting. Except on week ends, observations were made before and after school classes in Gloucester; 25 visits to the nest were made on 20 days. The periods of observations totalled 41 hours and 15 minutes.

HABITAT

Wilderness is apparently not a nesting requirement of the Red Crossbill. The Andrews Point nest was located in a pitch pine (*Pinus rigida*) within a few feet of a summer cottage. At Shoal Waters the nest was only 8 feet from a stone wall enclosing the property, and not more than 15 feet from the road. It was at the edge of a grove of 93 Japanese black pines (*Pinus thunbergii*) which were fruiting abundantly and formed a convenient food supply for the nesting pair. Across the road were sumac (*Rhus typhina*), privet (*Ligustrum vulgare*), and a small cherry (*Prunus* sp.) often used as a singing perch.

Weather Conditions

A complete weather chart for March 1 to April 18, furnished by the U.S. Coast Guard station at Eastern Point, shows a low temperature of 17 degrees, a high of 51, below freezing temperatures on 9 nights and an average temperature of 38 degrees. The wind velocity averaged about 15 mph; the highest recorded was force 8 (48 mph) on April 5. During the nesting period there was sun or broken clouds on 11 days in March and fog, rain, and snow on 15. In April there were only 3 days with sunshine or light clouds in contrast with 11 days of fog and /or rain.

Courtship

Since the nest was partly built when located, little courtship behavior was observed. On my first visit the male was singing brilliantly. This was probably a courtship song as it was never heard again. On March 14, while the female was building, the male sang from a tall elm in the adjoining property. Here the female joined him and both birds flew high around the grove in large circles, calling continuously, with the male in the lead. This (courtship?) flight ended with the pair dropping to the top of the elm, where the female still called loudly.

Nest Building

On my arrival at Shoal Waters on March 4, a male Red Crossbill (M) was singing from a cherry limb overhanging the road; 20 minutes later a female (F) flew into a small pine across the road. Carrying a twig in her bill, she went directly to a half-built nest, thus revealing its location. F then made five trips to the nest in three-quarters of an hour; on one trip she brought a six-inch privet twig on which she had been tugging vigorously. During this time M, a bird with mottled green and red plumage either accompanied F or sang near the nest tree. Once F fluttered her wings like a hungry juvenile and was fed by M.

Two days later, March 6, during a northeast drizzle, there were no signs of crossbills in the vicinity and the nest was no nearer completion.

Between 10 and 10:30 a.m. on March 9, F came to the nest tree three times with material, once staying on the nest and molding the interior by turning around vigorously. At noon on March 13 there was much crossbill activity in the grove; the nesting pair seemed to be courting and were feeding on the pine cones. M was singing often and both birds were calling. F made 5 trips to the nest, once bringing a white feather two inches long. During this hour F spent a total of 7 minutes at the nest.

By the next visit, on March 18, the nest was completed. Measurements taken later showed it to be 16 feet 2 inches from the ground and 24 inches

from the top of a small pine. It was saddled on a branch ½ inch in diameter and (contrary to descriptions of most other nests) only 2½ inches from the trunk, in a thick tuft of needles and cones. The outside was of loosely woven spruce twigs (*Picea* sp.), many of them from 90 to 160 mm. long. Inside were grass and weed stems, together with a few feathers and some felted material of vegetable origin. Measurements were: outside diameter, 120 × 140 mm.; inside diameter, 70 × 85 mm.; shape somewhat oval; inside depth, 35 mm.; outside depth, 60 mm.

Incubation

At noon on March 18 F was first seen on the nest, where her olive-green feathers blended perfectly with the surrounding pine needles. She was fed there three times by M, who signalled his arrival by calling. F kept up a soft *cheeping* much of the time. Returning at 3 p.m., I did not see F until 3:13 when she returned to the nest. The first egg was probably laid on this date. During the noon hour on March 20 the actions of both birds were similar and I judged that the third egg was laid. On this date, the female again left the nest after being on it more than an hour although the weather was inclement. On the 23rd and 25th I noted little activity—in the poor light F could not be detected on the nest until she moved. M was not seen at all between the 20th and 27th. On the latter date, when incubation must have been well advanced, it seemed safe to approach the nest tree. From a step-ladder placed under the tree, I raised a hand mirror wired to a 12-foot pole and saw three pale-bluish eggs, lightly spotted with reddish-brown. As reported by other authors, the female was a very close sitter. On my few inspections of the nest it was necessary to poke her off gently with some object. Squawking loudly, she would jump to the nearest twig, to return to the nest as soon as the mirror was removed. On April 1 F was still sitting closely. I saw her scratch and dress her feathers vigorously and, with opened bill, thrust her tongue in and out a number of times. During the entire incubation period F was only seen off the nest once; for the most part she sat quietly and moved little although her black and beady eyes seemed always alert.

Care of Young

The young probably hatched on April 2 (no visit) or April 3, when feedings were observed. For the next four days F brooded constantly during my visits. She was fed on the nest by M, and fed the young herself several minutes later. During this period the food regurgitated appeared thin and watery. On the 4th, after poking F gently off the nest, the naked appearing young were seen huddled in the bottom of the nest. By April 5 they showed a covering of gray down and were able to hold up their heads. On the 8th both parents

were bringing food. M always fed first but F regurgitated for longer periods, and sometimes brooded after feeding. Excreta was swallowed by both parents but more often by F. During the last week of occupancy, however, the rim and outside of the nest was whitened with excreta of the young. On April 12 inspection of the nest from an extension ladder showed three young, covered with dark bluish-gray down and with pin feathers now visible.

On this date and later, photographs were taken from a ladder 8 feet from the nest. This disturbance resulted in only a slight delay in feedings. On April 17, the nestlings' heads showed high above the rim of the well-filled nest. The young were never observed exercising their wings nor climbing about the nest. They were last seen at 5:30 that night. At noon on the following day nothing could be seen in the nest. M and F were calling and flying about in back of the nest tree but never came to it. At 3:30 p.m. I climbed the tree and found the nest empty. The young could not be located until 5 p.m. when one was seen in the driveway. M and F came within two or three feet as I picked it up, M being bolder and calling continuously. As this fledgling could barely fly it seemed doubtful that it would survive a night with numerous cats and dogs in the neighborhood. Consequently, it was taken for the Peabody Museum collection.

I left for a trip on April 18. On this date Jeffrey Thomas searched the grove thoroughly and found a pair of adult crossbills in a large, thickly needled pine, where he suspected they might be feeding young. On the two succeeding days no crossbills could be found anywhere in the vicinity.

A description of the fledgling follows: length 103 mm., tail 21, wing 51, culmen 12, depth of bill at base 8, tarsus 26, middle toe 16. Mandibles just starting to cross. Head and body striped with dark Grayish Olive to Olivaceous Black on pale Olive-Buff; tail and wings solid Chaetura Drab to Chaetura Black; some Old Gold on back, most noticeable on rump; bill dark Mouse Gray with a Cinnamon-Drab base; tarsus and toes Light Drab (Capitalized color terms from Ridgway's *Color Standards and Nomenclature*).

Songs and Calls

A rich warble suggesting the song of a Brown Thrasher (*Toxostoma rufum*) was heard for twenty minutes on the first visit; this musical song agreed with Pough's (1946:235) description of "an ascending series of double notes," though it lacked the final trill. This song was never heard again. During the first weeks, M's usual song was *z-z-zt, z-z-zt, z-z-zt*, all on the same note, in twos, threes, or fours. On March 17 he sang *whit-whit, zzzzt,zzzzt, zzzzt;* the last notes low and rasping. On the same date, when a courting flight (?) was seen, he also sang *pit-pit, tor-r-ree, tor-r-ree.* On April 16 M sang a new song: *whit-wheet* and *wheet, wheet, wheet,* changing pitch frequently and us-

ing doublets and triplets, with single notes interspersed. On the following day, when the young left the nest, the male sang many of the songs noted above, and called in a new and more rasping manner. The arrival of either bird in the vicinity was always signalled by *pip-pip*; there was much formless twittering or cheeping by both sexes. Calls were sometimes recorded as *pit-pit, whit-whit-whit, wheet-wheet,* or *whit-wheet.* F's lower and deeper tones could be distinguished from M's somewhat higher and softer calls.

Territory

No actions relating to territorial defense were noted. Cats crossed the yard below, dogs were always in the vicinity, a gray squirrel (*Sciurus carolinensis*) ran along the wall near the nest. A small flock of Black-capped Chickadees, (*Parus atricapillus*), Red-breasted Nuthatches (*Sitta canadensis*), and Golden-crowned Kinglets (*Regulus satrapa*) fed in neighboring trees. The crossbills ignored all this activity. Flickers (*Colaptes auratus*), a Phoebe (*Sayornis phoebe*), and Robins (*Turdus migratorius*) were nesting nearby, while Brown Creepers (*Certhia familiaris*), Ruby-crowned Kinglets (*Regulus calendula*), Cowbirds (*Molothrus ater*), Slate-colored Juncos (*Junco hyemalis*), and Song Sparrows (*Melospiza melodia*) fed in the grove or on the ground below. Other species were seen flying over the grove. At least two other pairs of Red Crossbills fed in the grove, both of the males with mottled plumage. These other crossbills were observed on March 23 and 25 and on April 3 and 8. Except for one occasion late in the nesting period when she came off the nest, F incubated or brooded quietly with no response to their calls and movements.

Summary

The activities of a pair of Red Crossbills were watched from the time a half-built nest was found until the young left the nest 45 days later. Observation periods totalled 41 hours. The female built the nest with the male in close attendance.

The nest was 16 feet 2 inches high in a small black pine on an estate bordering Gloucester Harbor, Massachusetts; there was abundant food in this grove of trees.

During the nesting period temperature averaged 38°F., wind velocity averaged 15 mph; the weather was cloudy or stormy 67 per cent of the time.

The female alone incubated the eggs; she was fed on the nest by the male.

For the first 4 to 5 days after hatching, the young were fed by the female after the male had fed her. Subsequently the pair returned to the nest together, the male always feeding the young first, and more briefly. Food regurgitated, whether to female or young, was a whitish "pap." In early stages this was thin and watery; when the young were half-grown it changed to a

thicker substance transferred in soft balls. Usually it was the female who removed the excreta and swallowed it but the nest became fouled by excreta in the later stages of nestling life.

Young left the nest at the age of 15 or 16 days.

Various types of songs and calls are described.

The young were not seen after the day they left the nest. One fledgling was collected and its plumage is herein described.

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Peabody Museum, Salem, Massachusetts, November 29, 1953

BIRDS AND BIOGEOGRAPHY OF THE SIERRA DE TAMAULIPAS, AN ISOLATED PINE-OAK HABITAT

BY PAUL S. MARTIN, C. RICHARD ROBINS, AND WILLIAM B. HEED

NUMEROUS distributional accounts of Mexican animals have appeared in recent years, amplifying our understanding of a rich, complex, and highly diverse fauna. Few studies, however, have related local faunas to climatic and vegetation types as outlined by Leopold (1950). By the focusing of study on a single plant formation or vegetation type, rather than on a political or other nonenvironmental unit, certain zoogeographic problems, such as Pleistocene influences on distribution patterns, are opened to investigation. The following account illustrates an application of this viewpoint.

In northeastern Mexico two small ranges, the Sierra San Carlos and Sierra de Tamaulipas, rise from the Tamaulipan Coastal Plain, completely isolated from the abrupt escarpment of the Sierra Madre Oriental. The higher parts of these ranges are covered by belts of open pine-oak woods, similar in structure and presumably in climate, to extensive forests of this nature in the adjacent Sierra Madre. They are isolated from the latter and from each other by the arid tropical thorn forest and thorn scrub of the intervening coastal plain (map 1), and thus constitute environmental islands for species inhabiting the pine-oak formation.

The coastal plain Sierras have been visited by comparatively few collectors and no faunal reports have appeared beyond that of Dice (1937) and others on the Sierra San Carlos. The pine-oak avifauna of the Sierra Madre Oriental in northeastern Mexico is somewhat better known and appears fairly homogeneous, judging from published accounts (Burleigh and Lowery, 1942; Harrell, MS; Phillips, 1911; Robins and Heed, 1951; Sutton and Burleigh, 1939; Sutton and Pettingill, 1943; Sutton, Pettingill, and Lea, 1942). Our preliminary faunal survey of the Sierra de Tamaulipas has been compared with these in viewing the relationships between the pine-oak areas of northeastern Mexico.

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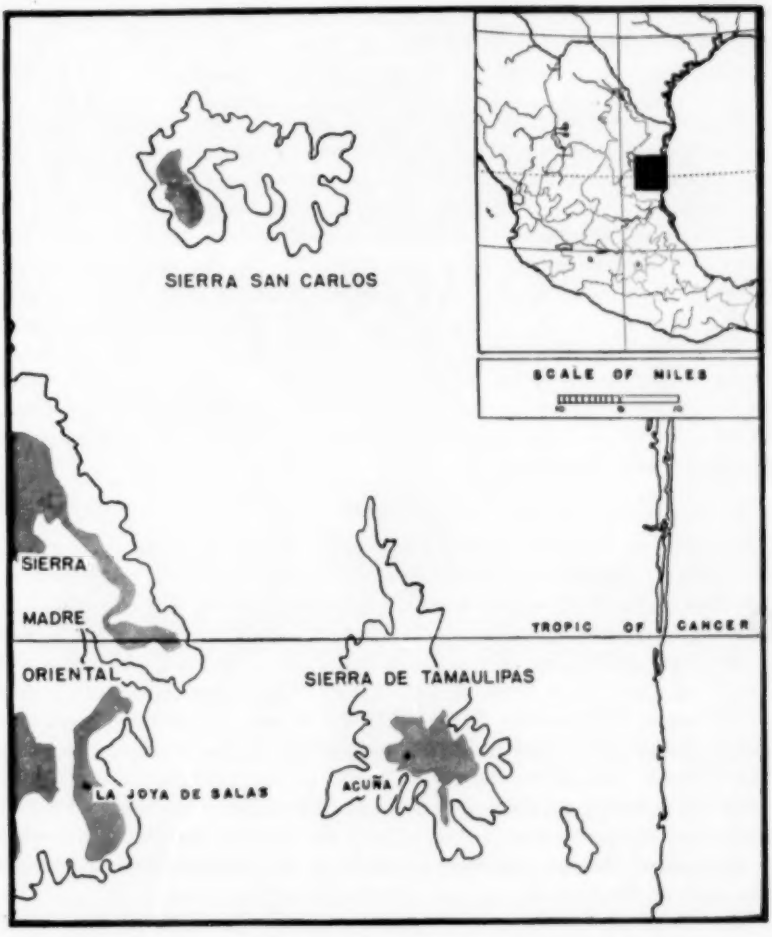

MAP 1. Distribution of the pine-oak belt (shaded) within the 2000 foot contour (outlined) in southern Tamaulipas. Contour interval from World Aeronautical Chart 522 and 589.

Reed at the Hacienda Acuña, by Sr. and Sra. Raul Sanchez of Santa María and by Mr. and Mrs. Irby Davis. For certain plant identifications we thank Robert T. Clausen. The following individuals have examined part or all of the manuscript and offered valuable suggestions: R. T. Clausen, P. Dansereau, L. R. Dice, E. P. Edwards, B. E. Harrell, K. C. Parkes, R. W. Storer, and C.

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Itinerary

We entered the Sierra de Tamaulipas on April 9, 1949, traveling from the lowlands near Gonzales north to the Hacienda Acuña (elev. 962 meters; for this and other localities mentioned see the American Geographical Society millionth map N.F. 14, San Luis Potosí). About four miles northwest of Acuña at a slightly higher elevation we camped along a small stream in the pine-oak woods, collecting there until April 25. We did not return to the Sierra de Tamaulipas until June 2 when we remained until June 11, completing observations on nesting birds. In 1950, Marian and Paul Martin spent August 5 to 12 collecting mammals and reptiles at the village of Santa María (870 meters), a few miles east of Acuña. At least two other field parties including Starker Leopold and Helmuth O. Wagner in one and Chester Lamb in the other visited Acuña prior to our trip; we have no detailed information on their discoveries.

Geology

Rising from the Gulf Coastal Plain north of the Tampico Embayment, the Sierra de Tamaulipas extends along a north-south axis for approximately 100 kilometers. It is roughly spatulate in shape, reaching a maximum width of about 60 kilometers in the south. Most of the higher parts of the range, those above 600 meters, lie in this wider southern portion just below the Tropic of Cancer and north of 23° N Lat. The highest peaks apparently do not reach 1400 meters. The topography of this area is rolling and dissected, comprising a series of sharp ridges and narrow valleys with some hilly plateaus near Acuña and Santa María. Coastal plain and low mesas to the north and west separate the Sierra de Tamaulipas from the Sierra San Carlos and the Sierra Madre Oriental. On the east the coastal plain extends to the Gulf of Mexico, interrupted only by a low range of hills, the Sierra San José de las Rusias.

The Sierra de Tamaulipas is considered the southernmost of a series of low anticlinal mountains which, isolated from the main mass of the Sierra Madre and from each other, lie east of the Sierra Madre and extend north to the Sierra del Burro of northern Coahuila (Muir, 1936). The Tertiary history of these mountains is especially significant. During this period the mountains of the coastal plain are thought to have formed low islands, slowly emerging from the Eocene Sea; by Middle Eocene time, and later, they composed the eastern margin of the Mexican continent (Muir, 1936). Thus their history indicates complete geological isolation from the front ranges of the Sierra Madre Oriental.

Weather

During mid-April we recorded morning temperatures of 54° to 58° F, rising to an early afternoon maximum of 75° to 80° and falling again to 60° by nightfall. Early morning clouds which often gathered around a pine-covered ridge near our camp usually were dissipated by 10:00 a.m. On the afternoon of April 15, rising winds and falling temperatures heralded the arrival of a mild "norte" or norther which brought very heavy winds by sundown. The following morning was dark, cold, and windy with a low of 45°.

During early June we found the weather much warmer than in April, though never oppressively hot. In August, maximum-minimum readings taken at Santa María from the 6th through the 10th were as follows: high, 85° to 88°; low, 55° to 64°.

In the Sierra de Tamaulipas, as in most of northeastern Mexico, the rainy season lasts throughout the summer and autumn with the dry season beginning in early winter. At this time the trees of the tropical deciduous forest shed their leaves and remain leafless until late spring. In 1949 an unusually severe dry season resulted in a water shortage so that by early June the pools near our camp were almost the only source of drinking water for both the residents and the cattle of the Hacienda Acuña. According to Howard Reed, supervisor of the Hacienda, precipitation is heaviest during the months of August and September when torrential rains are frequent and travel is difficult. However, little rain fell during the time the Martins visited Santa María.

Vegetation

We recognize the following four major animal habitats in the Sierra de Tamaulipas:

1. Tropical Thorn Forest. Characteristic of the driest parts of the Tamaulipan Coastal Plain is a low scrub, averaging 2 to 3 meters in height. Locally it may be almost impenetrable; however, many areas are more open, grading into a savanna formation when not overgrazed. Little time was devoted to faunal studies in this habitat.

2. Tropical Deciduous Forest. This formation, analogous to Carr's Monsoon Forest (plates 25 and 26, Carr, 1950), is well developed in local areas with greater available moisture than that required by the low thorn forest. The ravines and slopes of the Sierra de Tamaulipas between 300 and 700 meters are covered by this type of dense growth in which the tallest trees attain 20 meters and a continuous canopy averages 8 meters in height. Here are found a number of Neotropical bird genera, such as *Crypturellus, Momotus, Piaya, Xiphorhynchus,* and *Nannorchilus,* which seldom enter other habitats in this region.

3. Montane Scrub. In certain dry areas between 600 and 900 meters, above the tropical deciduous forest, are various combinations of low thickets or savannas composed of huisache (*Acacia farnesiana*), oaks, and some trees of the tropical deciduous forest. This habitat is usually lower in height than either the tropical deciduous forest or the pine-oak woods. Near the Acuña landing strip (900 meters) thickets of this type were inhabited by *Basileuterus*

FIG. 1. Open pine woods with discontinuous crown cover. Photographed at about 1000 meters near Acuña, Tamaulipas, by William B. Heed.

rufifrons and *Toxostoma longirostre* while the more open huisache savannas were favored by *Chamaethlypis poliocephala* and *Aimophila botterii*.

4. Pine-Oak Formation. Pine and oak forests interspersed with grassland are characteristic of the Sierra above 800 meters. Our field studies were devoted mainly to this habitat. Dominant trees include *Pinus teocote*, *Quercus arizonica* (reported by Leopold, 1950), other species of *Quercus*, and hard shell hickory (*Carya* sp.). On a few slopes oak thickets and scattered live oak trees are found as low as 300 meters (near Misión), but they are infrequent at such low elevation. Within the Pine-Oak Formation there is considerable variation in development and distribution of the forest and grassland areas; many ridges and high meadows are entirely covered with short grass, others grade into either pine or oak savannas and these into woods with complete crown closure. Less than 50 per cent of the area is actually covered by woods. In only a very few wooded areas is crown cover sufficiently dense to prevent dessication of the thin ground litter. One of these excep-

tional areas was a narrow sheltered ravine near a cliff south of Acuña where moisture was conserved; here we found several species of orchids, large tank bromeliads, and jack-in-the-pulpit (*Arisaema*). The entire area of this small pocket was barely 200 square meters. Along a few ravines and stream courses vegetation was also luxuriant, maidenhair ferns were present, and here we found the Black-headed Nightingale Thrush, *Catharus mexicanus*.

FIG. 2. Pine savanna and exposed ridge at about 1100 meters near Acuña, Tamaulipas. Note low palmettos and agaves in foreground. Photographed in April, 1949, by C. Richard Robins.

Among the generally scarce shrubs, we noted a scrub palmetto and a small cycad (*Dioon* sp.). On barren ridges grow a low chamaephytic oak and a small *Agave*. In addition to bunch grass we found considerable bracken (*Pteridium aquilinum*) under the pines. As epiphytes on the oaks grew abundant Spanish moss (*Tillandsia* sp.), a member of the Crassulaceae (*Echeveria* sp.) a few orchids, and a few tank bromeliads.

Near the village of Santa María some selective pine lumbering is presently in progress.

FAUNAL NOTES

Our mammal and bird collections are now part of the George M. Sutton Collection and the herpetological collection is at the University of Michigan. A few plants were presented to the Wiegand Herbarium of Cornell University. The majority of our collections were made in the pine-oak habitat above

800 meters and except where noted, the following faunal discussion is confined to species inhabiting the Pine-Oak Formation.

Fishes of the families Cichlidae and Characinidae were abundant in a tiny stream at Santa María and in deeper pools downstream above a 20-meter falls at Las Pilas. None were present in the pools near our camp site which contained newts (*Diemictylus*). Below these pools there was no surface drainage. About 1000 meters downstream from them was an abrupt cliff and, presumably, a waterfall in the rainy season.

Taxonomic analysis of the reptile and amphibian collections is presently in progress; most of the mammals have been discussed by Hooper (1947, 1952, 1953).

Amphibia.—*Diemictylus* sp., *Bufo horribilis, B. valliceps, Syrrhophus campi, Eleutherodactylus latrans, Hyla baudinii, Hyla* sp., *Rana pipiens.*

Lizards.—*Lepidophyma* sp. (two collected at Santa María), *Sceloporus variabilis, S. cyanogenys, S. grammicus, S. olivaceus, Cnemidolphorsu sackii, Ameiva undulata, Eumeces dicei, E. tetragrammus.*

Snakes.—*Leptotyphlops myopicus, Coniophanes imperialis, Drymarchon corais, Drymobius margaritiferus, Leptodeira annulata, Thamnophis sauritus, Micrurus fulvius.*

Turtles.—*Kinosternon herrerai* (collected from a pool near camp: identified by Norman E. Hartweg).

Mammals.—Among the mammals that we saw but did not collect were many white-tailed deer (*Odocoileus*), rabbits (*Sylvilagus*), and one peccary (*Pecari angulatus*). Coatis (*Nasua narica*) were common in remote areas away from the villages; one specimen was taken in the pine-oak woods. Tree squirrels of two species (*Sciurus aureogaster aureogaster* and *S. deppei negligens*) were common, the former in the *Tillandsia* of the oaks and hickories, the latter in the pine woods and the tropical deciduous forest. Several specimens of both were collected, including melanistic individuals of *S. aureogaster*. Small mammals trapped near Acuña included *Liomys irroratus texensis, Reithrodontomys fulvescens intermedius, Peromyscus leucopus texanus, P. pectoralis collinus, P. boylii levipes* and *Sigmodon hispidus toltecus* (Hooper 1947, 1952 and 1953).

Birds.—The following account of 72 species includes only the resident birds of the pine-oak belt; an asterisk indicates that we are uncertain whether the species so marked actually breeds in the pine-oak belt. Weights listed are in grams; fat classification follows the system of McCabe (1943). With few exceptions nomenclature follows that used in the following works: Cory, Hellmayr, and Conover, "Catalogue of Birds of the Americas"; Friedmann, Griscom, and Moore (1950); and the A.O.U. Check-list, fourth edition with supplements.

Coragyps atratus, Black Vulture. We found several large gatherings of vultures feeding on dead cattle; twenty to thirty Black Vultures came to devour a drought-killed heifer near camp.

Cathartes aura, Turkey Vulture. Seen daily, but never in as large numbers as the Black Vulture.

Buteo jamaicensis, Red-tailed Hawk. Seen occasionally in April, June, and August, indicating that they probably breed in this part of Tamaulipas.

Buteo albonotatus, Zone-tailed Hawk. Several pairs of Zone-tailed Hawks inhabited the Acuña area. One pair frequented cliffs along a ridge west of camp. On April 21, Heed and Robins discovered the nest of another pair in a pine at the foot of an escarpment overlooking a broad panorama of ridges three miles south of Acuña. This nest, constructed of twigs and oak branches and lined with fresh oak leaves, was about 40 feet above the ground and contained two whitish eggs. Friedmann, Griscom, and Moore (1950) do not list this species from Tamaulipas.

Buteo nitidus maximus, Gray Hawk. One or two noted daily, usually in the oak woods at 900 meters. On April 12, Robins secured a female with enlarged ovary (largest oocyte 6 mm.). The stomach contained three lizards, two *Cnemidophorus sackii* and a *Sceloporus*. Weight 655 grams; fat classification moderate; wing 275 mm.; tail 196 mm.

Hypomorphnus urubitinga ridgwayi, Urubitinga. Common. A nest Heed discovered April 14 in pine-oak woods was located about 40 feet above the ground in the central crotch of a tall pine. A copulating pair was observed by Robins in June. Martin saw four (a family group) at Santa María in August. A male weighing 1010 grams with testes measuring 15 × 8 mm. was taken April 12. The "flags" of this specimen are tipped with less white than those of five other Mexican *ridgwayi* examined.

**Herpetotheres cachinnans*, Laughing Falcon. Robins noted a pair near camp April 18 and 23.

**Caracara cheriway*, Caracara. Uncommon. Single birds encountered April 15 and 24; two were seen June 8.

**Falco albigularis*, Bat Falcon. Martin watched a Bat Falcon pursue several Red-crowned Parrots (*Amazona viridigenalis*) on April 13. One was seen April 18 near high rocky bluffs west of camp.

Colinus virginianus, Bob-white. Two were seen April 17 and 22; an immature female was shot from a covey of six near Santa María on August 5. In the Sierra, quail were much less abundant than in the lowlands near Gonzales and Misión. A singing male (testes enlarged) collected June 6 was identified by Dr. Aldrich of the U. S. Fish and Wildlife Service as *aridus* approaching *maculatus*.

Cyrtonyx montezumae, Harlequin Quail. Robins flushed a pair April 22 about 5 miles south of Acuña and collected the male. A pair was noted June 10 along the road to Santa María (elevation about 800 meters).

Meleagris gallopavo, Wild Turkey. Common locally on wooded hillsides about Acuña.

Columba flavirostris, Red-billed Pigeon. Noted daily in flocks of five to ten at all elevations.

Zenaida asiatica, White-winged Dove. First seen April 19 when a flock of 15 passed overhead. On April 22 Heed noted flocks of 15 to 40 doves flying low through the mountain valleys. Small groups of breeding birds present in June.

Scardafella inca, Inca Dove. A common dove in the villages of Acuña, Santa María, and in the vicinity of our camp.

Columbigallina passerina pallescens, Ground Dove. Rather common both in April and June but in small numbers, usually pairs. Measurements of two males taken in April (testes enlarging): wing, 85 and 81 mm.; weight, 37 and 35 grams.

Leptotila verreauxi angelica, White-fronted Dove. Fairly common in the thickly wooded canyon bottoms below 800 meters where they called daily. Seen less often in ravines of the dry open oak woods at higher elevations.

The ovary and oviduct of a female collected June 6 were enlarged with several oocytes measuring 6 mm.

Amazona viridigenalis, Red-crowned Parrot. Common over the high pine ridges as well as in the tropical deciduous forest of the canyons. Large flocks often flew over our camp in the evening screaming *kee-yaw, graw, graw, graw*. In mid-April we witnessed small groups engaged in erratic courtship flights accompanied by much noisy squawking. The testes of a male taken April 12 measured 14 × 7 mm.: it weighed 294 grams. We were surprised to find that this parrot is not confined to the arid tropical Tamaulipan lowlands, but ranges over the dry open pine-oak ridges with such typically temperate species as Ravens, Olive Warblers, and Red Crossbills. The crop and stomach of our single specimen contained pine seeds. At Santa María farmers shoot many parrots raiding the milpas for corn.

Coccyzus americanus americanus, Yellow-billed Cuckoo. First heard on June 5 in an oak thicket near Acuña. Three females taken June 7 and 8 were in the process of egg laying with large ruptured ovarian follicles and exposed brood patches. The oviducts of two birds each contained an ovum. Measurements resemble those of the nominate race: wing 142, 142, 148; tail, 138, 145, 149 mm. Evidently both *C. americanus* and *C. minor* breed in the Sierra de Tamaulipas although they appear to favor different habitats, *americanus* the oak thickets above 800 meters, *minor* occurring more frequently in the tropical deciduous forest below 600 meters.

Ciccaba virgata tamaulipensis, Wood Owl. Heed collected a female April 15 in a small cave in the pine-oak woods. Others called infrequently in April and nightly in early June. Largest oocyte in the ovary of our specimen measured 3 mm.; weight was 333 grams. The stomach contained beetles and the tarsus and feathers of a trogon (*Trogon elegans*).

Chordeiles minor, Nighthawk. Several observed in late April. In June six to ten hunted over our camp valley every evening and on moonlight nights we heard their booming dives at every hour from dusk to sunrise. A nest with one egg found by Heed on June 7 was located on an old path in the oak woods.

Nyctidromus albicollis yucatanensis, Pauraque. Several were calling April 9 and 12 near camp. Martin shot a female in worn plumage June 7 south of Acuña (ovary, 9 mm.; largest oocyte, 4.5 mm.; wing 163 mm.; tail 139 mm.).

**Caprimulgus salvini salvini*, Salvin's Whip-poor-will. A female collected by Robins on April 13 had enlarged ovary and little fat; it measured as follows: wing, 163 mm.; tail, 123 mm.; weight, 56 grams. In early May near Zamorina we often heard their calls; only on the night of June 3 did we hear one near camp in the Sierra.

Cynanthus latirostris latirostris, Broad-billed Hummingbird. A male was seen June 4 in open oak woods south of Acuña. Measurements of a female with unenlarged ovary taken June 7 are: wing, 53 mm.; tail, 32 mm.; culmen, 22 mm.

Amazilia cyanocephala cyanocephala, Red-billed Azure-crown. Common throughout the pine-oak and oak woods. Five females were secured; one of these, taken April 21, contained an egg (shell unformed) in the oviduct. Measurements are: wing, 59, 59, 58, 57.5, 57; tail, 34, 33, 34, 32.5, 33; culmen, 22, 21.5 (3), 21; weights of three April birds were 6.5, 6.5, and 6 grams.

Amazilia yucatanensis chalconota, Yucatan Hummingbird. Noted infrequently April 10 to 24 in the canyon bottoms. Fairly common in June in brushy thickets and in the open oaks. Our three specimens are slightly more rufous below than *chalconota* from Texas, but are much paler than *cerviniventris* of Veracruz. Weight of an April female was 4.5 grams.

Trogon elegans ambiguus, Coppery-tailed Trogon. Fairly common in the tropical deciduous forest of the canyon bottoms; less numerous in the high pine-oak woods, but

breeding in both habitats. In June Robins found a nest ten feet high in an oak. The cavity was 16 inches deep. Weights of three males collected in April were 60, 61, and 70 grams.

**Chloroceryle americana*, Green Kingfisher. One seen June 6 at a spring in a wooded ravine, elevation 1000 meters.

Piculus aeruginosus, Bronzed Woodpecker. Fairly common in the canyon bottoms below 600 meters, noted less frequently in the open pine-oak woods above 900 meters. Weight of a female with enlarged ovary taken April 12, 78 grams.

Melanerpes formicivorus formicivorus, Acorn Woodpecker. Very common in open pine-oak woods. On June 6, Martin watched an adult feeding young at a nest 25 feet high in a dead pine. The following day Robins found another nest at which at least four adults were participating in the feeding of young. Measurements of two males and two females: wing, 133.5, 130, 132, and 128 mm.; tail 77, 79, and 76 mm.; culmen 29, 27.5, 27.5, and 28 mm. Wing measurements of this series are smaller than those of three males and four females from the Sierra Madre of western Tamaulipas which range from 135 to 142 (mean 138.5 mm). Further study may justify nomenclatorial recognition of Sierra de Tamaulipas birds.

Melanerpes aurifrons aurifrons, Golden-fronted Woodpecker. On April 22 Heed collected a female, weight 73 grams, in open pine-oak woods near camp. This species is much more common in the lowlands.

Dendrocopos scalaris symplectus, Ladder-backed Woodpecker. Common through the open pine-oak hills. Several family groups noted on June 8. Wing lengths of two males and a female, 99, 102.5, and 100 mm., are characteristic of this larger subspecies rather than of the nominate form.

**Phloeoceastes guatemalensis*, Flint-billed Woodpecker. The rolling call of this large woodpecker was heard infrequently in tropical deciduous forest below 600 meters. A pair, apparently in courtship, were observed June 5. At Santa María in August several were seen on oaks (elevation 800 meters).

Lepidocolaptes affinis lignicida, Allied Woodhewer. Fairly common both in the oak parklands and in the pine-oak woods above 800 meters. On June 5, Martin discovered a nest in an open oak woods near Cerro Marquita (1000 meters), north of Acuña. The nest cavity was about ten feet above the ground in the dead vertical branch of an oak. The three white eggs present were nearly spherical and slightly smaller than those of *Trogon elegans*.

The breeding range of *L. a. lignicida* has long been cited erroneously. In southern Tamaulipas we have found this species only in cool montane forests, including both oak-sweet gum cloud forest and pine-oak forest, between 800 and 2000 meters. Sutton has collected wintering individuals along the Rio Sabinas near Gómez Farías (100 meters) in February, but *Xiphorhynchus flavigaster* is the only woodhewer known to breed in the Tamaulipan tropical lowlands. Therefore we questioned the assertion (Griscom, 1932, 1950) that the occurrence of *lignicida* ". . . in the arid hills of Tamaulipas, is one of the few cases where a Subtropical Zone bird reaches sea level in northern Mexico." In subsequent correspondence with Griscom (letter of March, 1952) we learned that this concept originated with Bangs and Penard (1919) who state that a series of eleven *lignicida* were collected by Armstrong in ". . . the very arid tropical hills of the region north and west of Ciudad Victoria." We both have examined the gazetteer of localities from which the type series was taken (Phillips, 1911) and find no positive evidence of any records below 1000 meters. The elevation given for one of the localities, Realito, is 8000 feet. The description of this area, copied

from Armstrong's field notes, clearly suggests montane humid forest. Thus the Allied Woodhewer may be considered a reasonably good indicator of cool montane forest in the northern, as well as the southern, part of its range.

A male and three females were collected. Measurements: wing 107, 105, 109, and 108 mm.; tail 93, 92, 95, and 89 mm.; weights of two females, 31 and 30 grams. Tentatively we assign our specimens to the subspecies *lignicida* although they are decidedly paler than two topotypes of that form that we have seen.

Pachyramphus major major, Black-capped Becard. Not noted until June 3 when three specimens were collected in the pine and oak woods. On June 7 a singing male was noted in oak-hickory woods near Acuña.

Tyrannus melancholicus couchii, Olive-backed Kingbird. Robins heard one April 22 and collected a male June 4 in breeding condition. Seen frequently in June and August.

Myiarchus tuberculifer lawrencei, Dusky-capped Flycatcher. Fairly common in the oak and pine-oak woods. On June 7 Robins found a nest with four or five young in a cavity 15 feet high in an oak (elevation 1000 meters). Two males taken in April weighed 21 and 22 grams.

Contopus pertinax pertinax, Jose Maria. This conspicuous flycatcher, one of the most common birds above 800 meters, inhabits pine and pine-oak woods. In mid-April they began singing before sunrise, called vigorously through the day, and often continued until long after sundown. In June and in August they sang less; more often we heard their sharp note, *bink-bink*. Although we found no nests, gonad size and courtship displays indicated that the breeding was in progress.

Four Acuña specimens are somewhat darker above than eight *C. p. pallidiventris* of Arizona and resemble more closely a series of eight specimens of *C. p. pertinax* from Chiapas in the Michigan collection. Two males and a female weighed 27 (medium fat), 20 (little fat), and 30 grams (fat).

Camptostoma imberbe imberbe, Beardless Flycatcher. Singing near Acuña in June and at Santa María in August. Measurements of a male in breeding condition taken June 7 are as follows: wing 54 mm., culmen 8.5 mm.

Corvus corax, Raven. Noted throughout the Sierra. Several pairs were in the Acuña region in April and June; others seen at Santa María in August. *Corvus ossifragus imparatus*, common throughout the Tamaulipan Coastal Plain, apparently does not enter the mountains.

Parus atricristatus atricristatus, Black-crested Titmouse. Fairly common in the Sierra as well as in the lowlands. Wing of a male measures 71 mm.; weight 15 grams.

Thryothorus ludovicianus, Carolina Wren. This Wren is fairly common locally along ravines of the oak and pine-oak woods. Dr. George Lowery in a letter to Dr. G. M. Sutton (November, 1949) identified our eight specimens as *tropicalis* > *berlandieri* with the following comment: "For several reasons their closest relationships appear to be with *tropicalis* rather than *berlandieri*. One example looks just like typical *tropicalis*; the lighter-backed specimens lack the rufescence of intermediates from around Victoria; and the barring of the flanks is more or less dusky in all except one bird. We might call them *tropicalis* > *berlandieri*, though material in fresh plumage might show that they are typical *tropicalis* rather than intermediates."

Weights of three males (April 14, 15) are as follows: 19, 19, and 17 grams; of two females (April 14), 16 and 18 grams.

**Salpinctes obsoletus*, Rock Wren. Robins recorded several April 18 on a rocky hillside west of camp.

Catherpes mexicanus mexicanus, Canyon Wren. Recorded on four days in April and twice in June, usually along cliff faces or rocky outcroppings. A pair collected April 14 weighed 18 and 17 grams.

Toxostoma longirostre, Long-billed Thrasher. One was seen near camp April 13. Martin found a nest June 7 in a brushy thicket near Acuña. The nest was four feet from the ground and contained three blue eggs marked with small russet spots. Measurements of an immature male collected at Santa María on August 6 are: wing 98, tail 128, culmen 27 mm. In size this bird matches typical *T. l. sennetti* of Texas; however, more material is needed to demonstrate whether or not intergradation in color occurs with *T. l. longirostre*.

Turdus grayi tamaulipensis, Gray's Robin. Common in small flocks in April. A nest examined June 6 was 35 feet high in a hickory at camp. A female, moderate fat, taken April 16 weighed 69 grams; a male, no fat, weighed 74 grams (April 22). Testes of this specimen were blue gray as were those of another male shot March 1 near Gómez Farías.

Myadestes obscurus, Brown-backed Solitaire. Uncommon, several birds were heard frequently in ravines near camp.

Catharus mexicanus mexicanus, Black-headed Nightingale-Thrush. Although no *Catharus* were recorded in April, this birds was one of the first species we encountered upon returning to our camp site June 3. They sang daily from humid ravines among the pine-oak woods for the remainder of our stay and were in song at Santa María in August. One spotted immature was noted near Santa María on August 10. *Catharus mexicanus* is much more common in the Rancho del Cielo cloud forest near Gómez Farías. Four males with enlarged testes and a female with a large oocyte (8 × 7 mm.) were collected.

Sialia sialis, Bluebird. Fairly common, especially about the settlement of Acuña. On June 2 a bluebird was observed carrying food. Two juveniles were collected June 8 near camp. Measurements: two males, wing 99, 95; tail 67, 62; two females, wing 93, 96; tail 59, 60.

Poliopotila caerulea deppei, Blue-gray Gnatcatcher. Fairly common in April and, locally, in June south of Acuña. Three birds in breeding condition were secured. Measurements of these are: two males, wing 48.5, 46; tail 52, 47 mm.; one female, wing 47; tail 44.5 mm.

Vireo griseus micrus, White-eyed Vireo. Martin heard songs of this species south of Acuña on April 20. Wing of a male collected there on June 7 measured 58 mm.

Vireo huttoni mexicanus, Hutton's Vireo. Common in the pine-oak woods. Singing constantly in April and June. Heed watched a pair constructing a nest of Spanish moss 20 feet up in an oak. Five males, all with testes slightly enlarged, were collected. Wings measured 63, 64, 66 (3); weights of two were 11 and 12 grams.

Vireo olivaceus flavoviridis, Yellow-green Vireo. One pair noted April 23. Abundant in June both in the tropical deciduous forest and in the pine-oak woods to 1000 meters. Robins found a nest with four white eggs at camp June 9, 25 feet high in an oak. The oviduct of a female shot June 5 contained two eggs.

Vermivora superciliosa mexicana, Hartlaub's Warbler. Common. Noted daily on the open oak and pine-oak hillsides, usually in company with the equally common Pitiayumi warbler. Three birds collected April 15 and 22 were approaching breeding condition. Two of these (a male and a female) each weighed 9 grams.

Parula pitiayumi nigrilora, Pitiayumi Warbler. One of the most common birds in the Acuña region. Their wiry buzz could be heard through the pine-oak parklands as well as in the dense tropical deciduous forest of the canyon bottoms. Measurements of a male and two females are as follows: wing 54.5, 50, 49; tail 40, 38, and 36 mm.; weights 8, 7, and 7 grams.

Peucedramus taeniatus arizonae, Olive Warbler. In the pine and oak woods of the ridges we discovered this inconspicuous warbler. Robins collected what he thought was a copulating pair on April 17, but discovered upon preparing the specimens that the ovary of the female (very fat) was just enlarging. Testes of adult April males were enlarged with the seminal vesicles present; those of a one-year old male taken June 6 were only slightly enlarged. Weights of April males were 10, 12, and 12 grams; two females weighed 11 and 12 grams.

Our six Acuña birds are similar to the subspecies *arizonae*: they lack the olivaceous wash on the back and the broad yellow edging of the secondaries said to be typical of *giraudi* and are much duller on the throat and crown than *taeniatus*. Indeed the narrow lemon yellow edging of the secondaries is reduced to such an extent that we could separate our five adults from 25 *arizonae* males and 14 spring *arizonae* females on this feature alone.

Chamaethlypis poliocephala poliocephala, Thick-billed Ground-Chat. This shy bird of the scrub oak and huisache was common locally in April and June. The song, usually given from a low shrub, is a hurried *zip zip zip zip wichy wichy wichy*. Two specimens, both males, were collected.

Basileuterus rufifrons jouyi, Rufous-capped Warbler. Noted frequently in April and June; gonads of June specimens were enlarged. Brushy slopes of the montane scrub above 600 meters appeared to be their favorite habitat.

Tangavius aeneus aeneus, Red-eyed Cowbird. First recorded April 19, seen daily thereafter.

Cassidix mexicanus prosopidicola, Great-tailed Grackle. A female (weight 108 grams) was shot from a flock of five near camp April 12, elevation 1000 meters. Several were recorded April 16. This species is much more common in the lowlands. Our specimen is darker below and smaller than *C. m. mexicanus*.

Icterus graduacauda graduacauda, Black-headed Oriole. Common in the tropical deciduous forest as well as in the higher, open pine-oak woods. Measurements of three males and a female are as follows: wing 99, 94, 100, and 88; tail 95, 97, 101, and 92.5; weights 46, 48, 40, and 40 grams.

Icterus cucullatus cucullatus, Hooded Oriole. Several seen in the low scrub *Acacia* near Acuña April 19-21. Two males taken June 3 and 4 were in breeding condition. Measurements of three males: wing 87, 88, 85 mm.; tail 97, 95, 91 mm.; weight of one male (April 20), 26 grams.

Tanagra elegantissima elegantissima, Blue-hooded Euphonia. Heed shot a singing male in open pine-oak country south of camp June 4 (testes enlarged, brood patch present, no fat), but we failed to find others. *Tanagra affinis* and *T. lauta* occur in the tropical deciduous forest, but did not appear at higher elevations in the breeding season.

Piranga flaxa dextra, Hepatic Tanager. One of the most common birds of the Acuña region. In April groups of five to ten frequently were seen feeding on the ground along the open grassy ridges. On June 9 Robins found a nest seven feet high

in a small oak on a pine-oak hillside. The nest, a loose structure of twigs placed near the end of a small branch, contained three young about ten days old. Weights of an adult male and two females are 45, 38, and 40; of an immature male, 35 grams.

Piranga bidentata sanguinolenta, Flame-colored Tanager. Fairly common in the canyons and noted infrequently in the pine-oak woods. Ovaries of two females collected April 14 and 15 were enlarging; weights were 32 and 34 grams. A singing male shot June 5 was in breeding condition.

**Rhodothraupis celaeno*, Crimson-collared Grosbeak. Found mainly in the canyons below 600 meters and in the thorny thickets of the lowlands, although a small group was seen in an open oak woods four miles south of Acuña on April 9 (elevation 900 meters).

Guiraca caerulea interfusa, Blue Grosbeak. Fairly common at Acuña in April where flocks could always be seen in the fields. In June they were scattered, singing and paired. Common about the milpas at Santa María.

Sporophila torqueola, Ringed Seedeater. Common. Three males collected are not in full adult plumage so we are uncertain of the subspecies. At Santa María in August Martin saw several adult males with what appeared to be complete dark chest-bands, typical of *S. t. morelleti*.

Spinus psaltria psaltria, Arkansas Goldfinch. Small groups fairly common in the open pine-oaks in April. They were paired and singing commonly throughout the region in June. Very common about the village of Santa María. Measurements of two males are: wing 61 and 62 mm.; tail 40 and 42; weight of one 9.5 grams.

**Loxia curvirostra stricklandi*, Red Crossbill. Fairly common above 900 meters. Flocks of four to fifteen were noted near camp every day feeding in the pines. Four immature birds were taken (April 10 and June 6) along with ten adults; however, we found no evidence of nesting and gonads of all adults were small. No crossbills appeared at Santa María in August. Although our birds are smaller in wing measurements (average of five males 95.4 mm.) than typical *stricklandi*, the depth of the bill (average 12 mm.) and brick red underparts indicate this subspecies. Weights of three males: 40, 40, and 39 grams; of three females: 35, 38, and 40 grams.

Aimophila ruficeps boucardi, Rock Sparrow. Fairly abundant throughout the pine and pine-oak woods, favoring especially fallen trees, clumps of cycads, and any brush available for cover in the open woods. Young birds seen flying June 6 to 10.

Fourteen specimens were collected in all; those taken in August are too worn to be of value for measurements. Critical examination reveals differences in size and color between our specimens and typical *boucardi* from the Sierra Madre Oriental of Nuevo Leon. However, the differences are not outstanding and further study is necessary to determine whether this population warrants subspecific status. Measurements of five males and four females are: wing of males 61–63 (62), females 56–58 (57.1); tail of males 58–65 (62.6), females 58–62 (60); weights of five adults: 19, 21, 20, 22, and 20 grams.

Aimophila botterii, Botteri's Sparrow. On April 19, Robins shot a male in a burned-over section of the Canyon de las Animas. *A. botterii* was not recorded again until June 7 when several birds in breeding condition were collected in open *Acacia* and brushy fields south of Acuña (900 meters). On June 10 Heed and Martin noted numerous Botteri's Sparrows in thorn forest and savanna near Agua Fria (100 meters). Measurements of six males and two females are as follows: wing of males, 63–68 (65), females, 61 and 63 (62); tail of males, 62–66 (64), females, 57 and 64 (60.5).

Vegetation of the Pine-Oak Formation

In the Sierra Madre Oriental of Tamaulipas two climatically and physiognomically distinct types of oak-pine forest can be recognized, as follows:

1. An arid phase with widely spaced trees, the oaks generally round-crowned with gnarled branches, the pines of medium height, seldom exceeding 25 meters. The flora is often characterized by *Agave americana*, *Pteridium*, *Juniperus*, *Juglans*, *Arbutus*, and a wealth of grasses. The western slopes of the Sierra Madre Oriental around La Joya de Salas and Carabanchel and the drier portions of the eastern side are covered by this park-like woodland which is quite similar to the pine-oak belt of the coastal plain Sierras. In Novilla Canyon west of Ciudad Victoria and along the Dulces Nombres road west of El Barretal arid pine-oak woods with associated palms (*Sabal*) and chamal (*Dioon*) descend to less than 700 meters where they contact thorny scrub forest of the lowlands. This arid pine-oak woods is probably homologous to Muller's Montane Low Forest of Nuevo Leon and Coahuila (1939, 1947), characterized by a mild and semi-arid climate.

2. Humid pine-oak forests of tall, straight, closely spaced and narrow crowned trees which often reach 30 meters are a feature of more mesic portions of the Sierra Madre east of La Joya de Salas. A wealth of large tank bromeliads and other epiphytes, numerous ferns, selaginellas, and mosses appear here. Fir (*Abies*), yew (*Taxus*), *Tilia*, *Cupressus*, *Garrya*, *Cornus*, and *Myrica* are some of the associates of *Pinus patula*, *P. montezumae*, and the various oaks which comprise the dominant species.

Apparently the coastal plain Sierras are too dry to support this mesic type forest which is confined largely to higher parts of the Sierra Madre above 1500 meters on the eastern slope and 2000 meters or more on the western side. In Nuevo Leon and Coahuila, Muller (*op. cit.*) describes a Montane Mesic Forest with a cool, sub-humid climate. This appears quite similar in physiognomy to, and only slightly different in flora from, the humid pine-oak forest of Tamaulipas.

Despite certain floristic differences, the pine-oak belt of the Sierra de Tamaulipas is clearly the climatic equivalent of the arid pine-oak woods or Montane Low Forest of the Sierra Madre Oriental. Evidently the pine-oak belt of the Sierra San Carlos is also arid. In view of this physiognomic and climatic similarity, the coastal plain Sierras may be expected to exhibit a close faunal relationship to the arid pine-oak formation found along most of the Sierra Madre.

Fauna of the Pine-Oak Formation

1. Birds. Throughout the Mexican Plateau certain characteristic species can be expected wherever pine-oak forests are found, including the following:

TABLE 1

BIRDS LARGELY RESTRICTED TO PINE-OAK COMMUNITIES IN TAMAULIPAS

A. Species found both in the Sierra Madre Oriental and Sierra de Tamaulipas.	B. Species found only in the Sierra Madre Oriental.
Buteo albonotatus	*Columba fasciata*
Cyrtonyx montezumae	*Glaucidium gnoma*
Melanerpes formicivorus[1]	*Hylocharis leucotis*
Lepidocolaptes affinis[1-2]	*Eugenes fulgens*
Pachyramphus major[1]	*Trogon mexicanus*[1]
Myiarchus tuberculifer[2]	*Dendrocopos villosus*
Contopus pertinax[2]	*Empidonax difficilis*
Corvus corax	*Mitrephanes phaeocercus*[2]
Catherpes mexicanus[1-2]	*Aphelocoma ultramarina*
Myadestes obscurus[1-2]	*Parus wollweberi*
Catharus mexicanus[1-2]	*Troglodytes brunneicollis*
Vireo huttoni	*Melanotis caerulescens*[1-2]
Vermivora superciliosa[1]	*Catharus aurantiirostris*
Peucedramus taeniatus	*Catharus occidentalis*[2]
Basileuterus rufifrons[2]	*Sialia mexicana*
Tanagra elegantissima	*Ptilogonys cinereus*
Piranga flava	*Setophaga picta*
Piranga bidentata[1-2]	*Basileuterus belli*
Aimophila ruficeps	*Pheucticus melanocephalus*
Loxia curvirostra	*Hesperiphona abeillei*[1-2]
	Atlapetes pileatus
	Aimophila rufescens

1. Also nests in oak-sweet gum cloud forest (Harrell, MS).
2. Winters below 300 meters in the tropical lowlands.

Columba fasciata, Trogon mexicanus, Dendrocopos villosus, Melanerpes formicivorus, Contopus pertinax, Aphelocoma ultramarina, Troglodytes brunneicollis, Catharus occidentalis, Sialia mexicana, Peucedramus taeniatus, Pheucticus melanocephalus, and *Atlapetes pileatus.* In the Sierra Madre Oriental of Tamaulipas we found 44 species which are largely confined to the pine-oak formation at least at its lower limit (Table 1). Some of these such as *Parus wollweberi, Setophaga picta,* and *Aimophila ruficeps* apparently favor arid pine-oak woods, while others including *Trogon mexicanus, Catharus occidentalis,* and *Hesperiphona abeillei* inhabit the humid or Montane Mesic Forest. However, it would be premature to attempt a subdivision of the pine-oak avifauna into species favoring arid or humid communities; actually many forms range throughout both.

In the Sierra de Tamaulipas 20 of the 44 Sierra Madre species were found (Table 1, List A). Most of these are typical of arid woods in the Sierra Madre, although a few, such as *Lepidocolaptes affinis* and *Catharus mexicanus*, are not. We conclude that the pine-oak avifaunal component of the Sierra de Tamaulipas exhibits a strong relationship to that of the Sierra Madre despite the relatively small area and homogeneous nature of the pine-oak habitat in the former.

2. Mammals. Obviously our knowledge of the mammal fauna is meager; however, all the species recorded thus far, with the exception of *Peromyscus boylii*, are known to occur in the foothills or lowlands below the pine-oak belt. *P. boylii* is also the only species listed by Dice (1937) which might be confined to the pine-oak belt of the Sierra San Carlos.

3. Reptiles and amphibians. In contrast to the pattern of bird distribution the herpetological affinities of the Sierra de Tamaulipas are almost entirely with the lowlands. Admittedly our faunal sample is incomplete; nevertheless of the 25 species recorded, all but *Lepidophyma* and possibly *Eumeces dicei* range below the pine-oak belt, most of them occurring throughout the arid lowland scrub of northeastern Mexico. Of the entire group only *Eumeces dicei* is definitely disjunct in its zonal distribution, having been taken at 500 meters in the Sierra San Carlos, at about 900 meters in the Sierra de Tamaulipas, between 1100 and 2000 meters in the Sierra Madre near La Joya de Salas, and at 600 meters near Ciudad Victoria. It is especially significant that the highly diverse iguanid genus *Sceloporus* is represented in the Sierra de Tamaulipas by four species which are typical inhabitants of the lowlands, while those species abundant in the Sierra Madre near La Joya de Salas such as *S. torquatus*, *S. jarrovii*, *S. parvus*, and *S. scalaris* were not collected. Thus it appears that the mammals, reptiles, and amphibians exhibit very slight relationship to the pine-oak faunal component of the Sierra Madre.

Reptiles and amphibians reported from the Sierra San Carlos (Gaige, 1937) were taken mainly below the pine-oak belt. Virtually all of the species listed also inhabit the Tamaulipan lowlands; no forms restricted to the pine-oak formation were collected.

Discussion

Pollen studies correlated with archeological horizons from the vicinity of Mexico City (Sears, 1952) have thrown new light on the problem of Pleistocene climatic fluctuations far below the continental glacial border, and remove some of the burden of proof from evidence based on relict distributions alone. Evidence for the extreme views adopted by some that during the period of maximum refrigeration the South American faunal element was virtually destroyed in Mexico (Griscom, 1950) and the Tropical Zone was driven into a narrow coastal fringe in Central America (Beecher, 1950) is

largely circumstantial; but the more substantial data afforded by fossil records and relict mammal distribution patterns (Burt, 1949) suggests a definite refrigeration of climate in Mexico.

Although fossil evidence from the coastal plain of Mexico is lacking, we suspect that significant fluctuations of climate and vegetation occurred. In view of the pollen findings of Potzger and Tharp (1947) from Austin, Texas, which demonstrate major changes in the vegetation of that area, 500 miles north of the Sierra de Tamaulipas, it seems probable that northeastern Mexico was also affected. A climatic shift sufficient to lower the present arid pine-oak belt with its mild, semi-arid climate from the 700 to the 200 meter contour would establish habitat continuity between the Sierra Madre and the coastal plain ranges. At such a time faunal movement across the coastal plain would have been possible for species inhabiting the pine-oak belt.

Assuming then that faunal isolation in the Sierra de Tamaulipas is of post-Wisconsin age, we must account for the absence of a distinct pine-oak faunal component among the terrestrial vertebrates. Why are the relationships of the mammals, reptiles, and amphibians almost exclusively with the lowlands in contrast to the strong montane affinities of a third of the breeding birds? We offer the following two hypotheses:

1. Small habitat size. As previously mentioned, the pine-oak formation of the Sierra de Tamaulipas occupies a small area; it may cover less than 700 square kilometers. Optimal population conditions are not realized by animals restricted to small isolated habitats and the possibility of local extermination of species confined to this formation is much greater than for the same species inhabiting the extensive pine-oak belt of the Sierra Madre Oriental. Among the vertebrates, the birds, with their superior dispersal capacity, should be able to maintain balanced populations by occasional immigration from the Sierra Madre.

2. Post-glacial thermal maximum. In view of the xeric-mesic fluctuations dating to at least 2000 B.C. in the Valley of Mexico (Sears, 1952), and the xerothermic intervals postulated on the basis of pollen studies in eastern North America (Sears, 1948), it is probable that in recent times the pine-oak formation of the Sierra de Tamaulipas was somewhat constricted. If xerothermic conditions did prevail here, a retreat of the pine-oak woods to isolated peaks and north-facing ravines would follow, subdividing the habitat into numerous isolated pockets. Under such conditions animals confined to the pine-oak belt would be in danger both of increased competition from invading lowland species and local extirpation in an environment too small to support adequate breeding populations. As the habitat increased again under the return of favorable climatic conditions, only the birds succeeded in re-establishing part of the Sierra Madre faunal element.

Summary

Isolated from the main front of the Sierra Madre Oriental, the Sierra de Tamaulipas is surrounded by xeric thorny scrub of the Gulf Coastal Plain. A belt of arid pine-oak woods covering its higher slopes forms an environmental island of temperate forest for certain animals which reached this habitat from the Sierra Madre. Of 44 birds largely confined to pine-oak forests in the former, 20 were also found in the Sierra de Tamaulipas; however, virtually none of the amphibia, reptiles, or mammals restricted to this habitat in the Sierra Madre appeared in the Sierra de Tamaulipas.

On the assumption of Pleistocene connection between the pine-oak belts of the two Sierras, we postulate both small habitat size and a post-glacial xerothermic effect as responsible for the observed faunal composition of the Sierra de Tamaulipas.

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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN; DEPARTMENT OF CONSERVATION, CORNELL UNIVERSITY; AND DEPARTMENT OF ZOOLOGY, UNIVERSITY OF TEXAS, JULY 28, 1952

GENERAL NOTES

Baird's Sparrow in Oklahoma.—The paucity of migration records of Baird's Sparrow (*Ammodramus bairdii*) east of New Mexico and Colorado has long been a matter of interest to ornithologists of the mid-west. Nice (1924. Birds of Oklahoma:113) stated that Cooke had looked for this species at Caddo, Oklahoma, in 1883. Dr. Alexander Wetmore (1920. *Auk*, 37:457-458) made a thorough but unsuccessful search for Baird's Sparrows in eastern Kansas. Cartright, Shortt, and Harris (1937. *Trans. Royal Canadian Inst.*, 21:155) pointed out that migration records of this species are few, and that it seems largely to escape notice in migration. In their very useful paper they list migration records in sequence in order to show the passage of the birds from south to north. From this list it is clear that Baird's Sparrows pass through the region of New Mexico and Colorado in late April and early May.

In view of the above facts we considered it worthwhile to make a concerted effort to find Baird's Sparrows in central Oklahoma during the spring migration of 1953. Beginning our searches in mid-March, we regularly visited various types of habitat, but concentrated on upland grasslands and weedy fields. We made field trips from one to three times a week for the express purpose of finding this species.

Our search was rewarded on April 23 (1953) when R. Graber collected one of three Baird's Sparrows which he saw in a field three and one-half miles northeast of Norman. The field was of interest because of the variety of cover which it offered, with patches of various grasses and forbs, bare eroded areas and a few scattered clumps of wild plum (*Prunus* sp.). A short list of some of the common plants will help show the nature of the vegetation: grasses; *Aristida, Andropogon scoparius, Bromus, Festuca octoflora*: forbs; *Melilotus officinalis, Ambrosia psilostachya, Plantago virginica, Liatris,* and *Oenothera laciniata.*

In the same field were singing Grasshopper Sparrows (*Ammodramus savannarum*) and a few Savannah Sparrows (*Passerculus sandwichensis*). Like these sparrows, the Baird's Sparrows were reluctant to fly, preferring to run away through the grass, though they seemed less skillful in keeping themselves concealed than the first two species.

The specimen was a male, testes little enlarged, in somewhat worn plumage (the tail and upper tail coverts were badly worn). It weighed 18.2 grams, was moderately fat, and was molting on the head, neck, and upper breast.

Though we continued to look for Baird's Sparrows in succeeding weeks, we failed to find the species again. Cartright, Shortt, and Harris (*loc. cit.*) thought that the spring migration of this species is very rapid, and it is not unreasonable to suppose that the birds did pass through our study area in just a few days and that we encountered them only when the migration was at its peak.

Nice (*loc. cit.*) included Baird's Sparrow in a list of birds unreported but to be expected in Oklahoma. Force (1929. *Okla. Acad. Sci.*, 9:68), in a list of birds of Tulsa County, Oklahoma and vicinity included *Ammodramus bairdii*, but indicated its status there as uncertain, there being no specimen. In view of the secretive nature of Baird's Sparrows in migration and the possibility of confusing it with other migrants, Oklahoma records should generally be based on collected birds.

Our specimen is now in the University of Oklahoma Museum of Zoology (UOMZ 625). We wish to thank Dr. George J. Goodman for identifying several plant specimens.—RICHARD GRABER AND JEAN GRABER, *Museum of Zoology, University of Oklahoma, Norman, Oklahoma, May 18, 1953.*

Nest-building behavior of the Carolina Wren.—In the spring of 1953 we observed a pattern of nest-building behavior in the Carolina Wren (*Thryothorus ludovicianus*) that seems not to have been recorded previously.

The observations were made in our back yard on the border of a mesic hammock near Gainesville, Alachua County, Florida. There are about a dozen fairly large trees standing in the yard beneath which the underbrush has been cleared out but the leaf mold has been left largely undisturbed. In the area just south of the yard there is a dense thicket of underbrush under the trees.

The phenomenon observed was simply that when the wren, in gathering nesting material, picked up anything larger than a tiny leaf it did not fly directly to the nesting site but instead climbed up the trunk of a tree to a height above the nest and then flew down toward it with the load.

We first noticed this on May 10 when the wrens were collecting material from the leaf mold in the open yard. On this occasion the nest was situated close to the ground. The wrens would leave the nest, fly parallel to the ground and about a foot or two above it to the area where they were gathering the nesting material. With small items, they would take off from the ground and fly horizontally back to the nest, but with larger objects (a leaf an inch or more in diameter, a pine straw, etc.) they would hop to the nearest tree, climb straight up the trunk to an altitude above the level of the nest, then take off and fly downward to the nest. In a tree 44 feet from the nest they climbed to a maximum height of 14 feet and they climbed 16 feet up the side of a tree 49 feet from the nest. On one occasion, one of the wrens selected an item which appeared to be a piece of dead magnolia leaf about 2 inches in diameter. It hopped over some 8 or 10 feet to the nearest tree, which was 49 feet from the nest, climbed it to a height of 16 feet, but then, instead of flying downward directly toward the nest, it flew off at a tangent to another tree, landed on the trunk 8 feet from the ground, climbed to a height of 13 feet, and then flew downward toward the nest which was now only 25 feet away.

While collecting material in the shrubby area south of the nesting site the birds would also gain altitude before taking off for the nest but here they would simply hop up from twig to twig of the shrubs until they reached a sufficient altitude. Once we saw one hop from twig to twig until it reached the top of the shrub about 10 feet from the ground, then hop to a tree and ascend the trunk for another 4 feet above the level of the top of the shrubs. Both the male and the female take part in the nest building and both of them exhibited this same behavior.

While watching a pair (perhaps the same birds) building a nest in June we made a check of fifty flights and found that the birds climbed trees or shrubs to get altitude 28 times as compared to the 22 times they took off from the ground. This nest was placed under the eaves over the front step of our house and hence was about 8 feet from the ground. On several occasions the birds would pick up some item, then instead of hopping to the nearest tree they would fly close to the ground and land on the base of a live oak tree about 6 feet from the door. They would then climb up this tree to a height equal to or above the nest before concluding the final lap of the flight to the nest.

When we discussed this behavior of wrens with our friend, O. C. Van Hyning, he told us that he had seen them do the same thing when carrying food to the nestlings.—Coleman J. and Olive B. Goin, *Department of Biology, University of Florida, Gainesville, Florida, July 21, 1953.*

Notes on Some Birds of Yellowstone National Park.—While employed during the entire summer of 1952 in Yellowstone National Park, Wyoming, I had the opportunity to observe birds in various sections of the park. My notes contain several additions to our knowledge of the status and distribution of birds in this area.

Bufflehead (*Bucephala albeola*).—Brodrick (1952. "Birds of Yellowstone National Park," p. 12) indicates that this species has been found breeding within the park boundaries only once. Kemsies (1930. *Wilson Bull.*, 42:202) lists this duck as a migrant. On July 6, 1952, I found a female accompanied by seven downy young on a small pond separated from Yellowstone Lake by a sand-bar about one-quarter of a mile southwest of Fishing Bridge.

White-tailed Ptarmigan (*Lagopus leucurus*).—One individual was observed closely on the southeast side of Mount Washburn just above timberline on July 20, 1952. The only other record from the park is that of at least one bird seen on Quadrant Mountain in 1927 (Brodrick, *op. cit.*:18).

Sora (*Porzana carolina*).—This species has been cited by both Kemsies (*op. cit.*:203) and Brodrick (*op. cit.*:19) as being an "occasional breeder." My observations indicate that this was a common breeding species in the proper habitat throughout the park in 1952. During all of June the call of this species was obvious around Swan Lake Flats and also from a small, wet area near Madison Junction. On June 22, 1952, I heard at least seven of these birds and found a nest containing eleven eggs on the northwest side of Swan Lake. I saw five young in Upper Geyser Basin on July 7 and heard and saw others along Yellowstone Lake and River occasionally.

Wilson's Snipe (*Capella gallinago*).—Skinner (1925. *Roosevelt Wildlife Bull.*, 3:157) regarded this species as "not common." Again, both Kemsies (p. 203) and Brodrick (p. 19) regard this as only an "occasional breeder." I heard one bird every morning and evening in the Upper Geyser Basin during June and early July. I flushed two birds from Swan Lake Flats on June 22, 1952, and one adult with three or four young along Yellowstone Lake about seven miles north of Thumb on July 5. Considering all records, I think that the present species is an uncommon but regular breeding bird in the park.

Western Wood Pewee (*Contopus richardsonii*).—This species has apparently extended its range up into the lodgepole pine (*Pinus contorta*) forests of the Canadian Zone to some extent from the lower elevations. I observed and heard it commonly all summer from Upper Geyser, Black Sand and Biscuit Basins. Bailey (1930. "Animal Life of Yellowstone National Park.") and Kemsies (*op. cit.*:206) state that this species is a "common summer resident" only at the "lower altitudes."

Barn Swallow (*Hirundo rustica*).—This species is rare in summer in the park region. Barn Swallows nested about five miles north of Thumb along Yellowstone Lake in 1952. I saw two adults here five times during June and two adults and four young in the same area on July 27.

Lark Sparrow (*Chondestes grammacus*).—Termed a "rare summer visitor at the lowest levels" by Brodrick (*op. cit.*:50), I found this species to be fairly common during migration in late summer mixed in with flocks of Savannah Sparrows (*Passerculus sandwichensis*) and Chipping Sparrows (*Spizella passerina*) in the Upper Geyser Basin during late August and early September.

Brewer's Sparrow (*Spizella breweri*).—Bailey stated that this species was a common summer resident in the sagebrush valleys but Kemsies and Skinner regarded it as a rare breeder. I did not find the nest of this species but during June and most of July I heard and observed one male in the Biscuit Basin. This single bird frequented brush piles and was seen so regularly here that I suspect it had a mate and nested here.—Richard C. Rosche, *Cornell University, Ithaca, New York, April 21, 1953.*

Yellow-bellied Sapsucker on Anegada, British West Indies.—On January 24, 1950, I collected a female Yellow-bellied Sapsucker (*Sphyrapicus varius*) from a cocoanut tree on Anegada Island. My guide informed me that this bird was not uncommon and that he saw "woodpeckers" every year. Sapsuckers are ordinarily rare migrants in this part of the world. The island of Anegada, covered with the most meager xerophilous scrub and only thirty feet above sea level, hardly appeared to be the place to find one. I believe this a new record for the island. The bird is No. 26 in my collection.—GEORGE A. SEAMAN, *Christiansted, St. Croix, Virgin Islands.*

Injury-feigning by the Catbird.—At the 1949 annual meeting of The Wilson Ornithological Club, Mr. Frederick V. Hebard gave a paper entitled "Survey of injury-feigning birds on the A.O.U. checklist." At that time there were no published records of injury-feigning by members of the family Mimidae, and, so far as I know, there have been none since. Mr. Hebard informed me later (letter dated January 10, 1950), however, that a Catbird (*Dumetella carolinensis*) he had observed (during the first week of August, 1949) "feigned mildly for the first several days after the eggs had hatched." He added that "this was the first Catbird nest from which I had ever surprised the adult bird."

On May 30, 1949, I flushed a Catbird from a nest containing five eggs. The bird flew to a gravel road only a few feet away and gave a modified broken-wing display, *i.e.*, fluttered its wings moderately fast as it moved slowly along the road away from me and the nest. The same behavior was repeated the following day, when there were still five eggs. The nest was destroyed before my next visit.

That injury feigning is not a common behavior pattern of the Catbird is indicated by the lack of published records and by the fact that I have observed it only at one nest in a six-year period, during which I observed 118 nests of this species.

A more common type of behavior of the Catbird when surprised on its nest is an intimidation display. In this, the incubating bird moves only a short distance from the nest before advancing with outstretched wings toward the observer, giving the typical loud alarm note repeatedly. Catbirds have, on several occasions, approached to within two or three feet of me with their wings outstretched in this manner.—ANDREW J. BERGER, *Department of Anatomy, East Medical Building, Ann Arbor, Michigan, July 20, 1953.*

Brewer's Blackbird nesting in Indiana.—Although a number of sight records and one specimen (Mumford, 1951. *Wilson Bull.*, 63:47) of Brewer's Blackbird (*Euphagus cyanocephalus*) have previously been reported from Indiana, it was not until the spring of 1952 that the first nesting record was established. Since 1949 sight records have been obtained from Lake, St. Joseph, Newton, Porter, Pulaski, Noble, and Wayne counties. I have failed to find any earlier reports and Butler (1898. *Indiana Dept. Geol. Nat. Resources Ann. Rep.* 22:1178) carried the species on the hypothetical list.

Hubert O. Davis, W. Marvin Davis, and Richard E. Phillips observed a number of Brewer's Blackbirds of both sexes on a small, isolated remnant of prairie near Schererville, Lake County, Indiana, April 8, 1949. They also recorded the birds there in 1950 and 1951, but no search for nests was made. On May 11, 1952, Phillips found at least ten pairs of Brewer's Blackbirds on the area and was successful in locating a nest. It was on the ground in a rather dense growth of switch grass (*Panicum virgatum*) remaining from the previous year. This had fallen over and formed a tangled mat over the ground. The nest was sunken into the ground so that the rim was level with

FIG. 1 Brewer's Blackbird nest and eggs, Lake County, Indiana, May 11, 1952. Photo by Frank E. Phillips.

the surface. The nest contained five eggs (Fig. 1). Phillip's measurements of the nest are as follows: inside depth, 2½ inches; inside diameter, 3¾ by 4¼ inches. The nest was composed of grasses and lined with fine rootlets. It was on a dry site, although the lower depressions on this tract contained water, in which were growing *Scirpus, Iris,* and other aquatic or semi-aquatic plants. Two cottonwood trees (*Populus deltoides*) were within 70 yards of the nest and were utilized by the males as singing perches. Two dense thickets of quaking aspen (*Populus tremuloides*) were situated within 100 yards of the nest, but the remainder of the approximately 12-acre tract surrounding the nest was relatively open, except for scattered aspen of small size.

Phillips, Mrs. Mumford, and I visited the nest on May 17, 1952. There was a light rain falling at the time and we flushed the female from the nest. It contained three small young and two eggs. Dr. C. M. Kirkpatrick, Phillips, the Davises, and I visited the nest again May 30 and found it empty; we caught two fledglings near the nest, however, and observed both adults carrying food to the young from a field one-half mile away.

During our visit on May 17, we investigated the area about the nest carefully without finding evidence of other nests. We did locate a nest with three eggs about 300 yards southeast of the first one, in a partially-barren field which has been under cultivation the

previous year. The female was flushed from the nest, which was on the ground in the center of a clump of weeds. Both adults flew about over our heads scolding us while we examined the nest.

Further investigation of a similar tract of land across the highway from these two nests resulted in our finding a third nest, which contained one egg. This nest was also in a clump of vegetation in a field cultivated the year before. It was on the ground and constructed of soybean stems from the previous year's crop and lined with fine rootlets. It contained no mud. The nest and egg were collected and have been deposited in the Joseph Moore Museum, Earlham College, Richmond, Indiana. The following measurements of the nest were taken: outside diameter, 132 by 160 mm.; inside diameter, 90 by 92 mm.; inside depth, 52 mm.; and outside depth, 90 mm.

Two more nests were located in the vicinity of this one on May 30. Both were in the same type of situation as the second and third nests above and they contained young almost ready to fly. We noted that the nesting birds became very excited as we approached a nest site. By studing the intensity of their scoldings, we found one nest more easily. All five of the above nests were placed within an area roughly 300 yards wide and 880 yards long. It is quite likely that more nesting pairs were present, since we observed 18 adults on May 17, most of which were males.

Another nesting record was established on May 23, 1952, when Mr. and Mrs. Ray Grow, James B. Cope, and Robert Lewis discovered a nest containing five young and one egg in Pine Township, Porter County, Indiana. This nest was on the ground in an alfalfa field about 30 feet from the edge of a plowed field. Four males and two females were observed in the area at the time.

The nesting of this species has probably been overlooked for some years in Indiana. On areas where muck farming is practiced, it seems that the birds might be present. Brewer's Blackbirds were rather common in Newton County, Indiana, during late March, 1953. Many flocks were noted with Cowbirds (*Molothrus ater*), Red-wings (*Agelaius phoeniceus*), and Rusty Blackbirds (*Euphagus carolinus*). I made a brief visit to the Schererville area on May 11, 1953, and collected a male and a female Brewer's Blackbird; I observed 13 on the area at this time, but had no opportunity to search for nests. The specimens have been deposited in the Joseph Moore Museum.

I wish to thank Richard E. Phillips for permission to publish the above data and Frank E. Phillips for the accompanying photograph. Thanks are also extended to James B. Cope for supplying the data on the Porter County nest.—Russell E. Mumford, *Route 1, Cortland, Indiana, August 11, 1953.*

Wintering Blue and Snow geese in northern Alabama.—Blue Geese (*Chen caerulescens*) and Lesser Snow Geese (*Chen hyperborea hyperborea*) in the eastern United States normally winter in the coastal marshes of the Gulf of Mexico. There are scattered winter records in the interior, but the establishment of a small flock wintering regularly on the comparatively recent impoundments of the Tennessee River is new and interesting.

Impoundment of the Tennessee Valley Authority's reservoirs on the Tennessee River began with the completion of Wheeler Dam in 1936, followed quickly by the completion of the Guntersville, Pickwick, Kentucky, and other dams. Prior to these impoundments, Blue and Snow geese were virtually unknown to residents of the Tennessee Valley. Howell's "Birds of Alabama," last printed in 1928, lists both species as only rare and irregular migrants in the state. With Wheeler Reservoir impounded in 1936, Blue

and Snow geese stopped briefly in the fall of 1937. Since then, these birds have stopped regularly on Wheeler each fall and are now noted each autumn on all the lower impoundments, including Guntersville, Wheeler, Wilson, Pickwick, and Kentucky reservoirs.

The establishment of the Wheeler National Wildlife Refuge in 1938 by the U. S. Fish and Wildlife Service on the middle third of Wheeler Reservoir provided an added incentive to the birds to stop and rest. While the stopovers have occurred regularly, numbers have varied widely. In 1939 the writer estimated that 2,000 were present on the refuge during late October and early November. In 1945, Mr. L. S. Givens, then refuge manager, estimated 5,000 present on the sanctuary during the fall flight. In other years the number present at the peak of the flight has varied from 100 to 1,000.

For both species the earliest fall arrival date for the refuge is October 2. Normally the peak of the flight occurs the last week of October and the first week of November. By the third week of November the flight is over and the migrating birds have passed on to the Gulf. Although rarely pure flocks of both species are noted, they are commonly mixed, with Snow Geese comprising from 5 to 10 per cent of each flock.

For ten years after the establishment of Wheeler Refuge the birds continued their status as fall migrants only. Occasionally single birds or small groups of 2 or 3 were noted in middle or late winter, usually in company with Canada Geese (*Branta canadensis*). These were assumed to be sick or crippled birds that failed to migrate. The first wintering in numbers occurred in 1948–49 when a flock of 20 Blues and 5 Snows remained until late March. During the winter of 1949–50, 400 Blue Geese and 30 Snows stayed over until early spring. Again, in the winter of 1950–51, 500 Blue Geese and 40 Snows were present until mid-March, although the winter was severe, with considerable snow and ice. Strangely enough, during the winter of 1951–52, characterized by mild weather, only a few stragglers were present. The winter of 1952–53 saw them present again, with an estimated 200 Blues and 15 Snows using the refuge until early spring.

The fluctuating waters of Wheeler Reservoir prevent the growth of any significant amounts of aquatic vegetation, and the waterfowl management of the refuge is based on the growing of agricultural crops on upland fields and leaving portions unharvested for wintering waterfowl.

A part of the land is also kept in small grain, alfalfa, and other green winter crops to provide grazing for geese. While Canada Geese make good usage of both browse crops and unharvested corn, the Blue and Snow geese seemed to depend entirely on natural mud flat vegetation until the winter of 1949–50. During that winter they made limited use of both browse and corn. Since then, they have fed regularly on upland fields.

While these geese are said to remain close to the Mississippi Valley on their northward migration, there have been indications, during the last few years, that there may be a limited spring flight through northern Alabama. Those birds that have spent the winter on Wheeler Refuge have left during the period between the last few days of February and mid-March. A few scattered flocks have been noted moving through this area in April. This has occurred with some regularity and as late as April 28. It is believed that these April birds have wintered elsewhere. It seems clear that the impoundment of the five lower reservoirs on the Tennessee River, aggregating over a quarter-million surface acres of water, is modifying both the winter range and the migration routes of these species to some extent.—THOMAS Z. ATKESON, *Box 1643, Decatur, Alabama, May 29, 1953.*

Courtship behavior of the Pied-billed Grebe.—Pied-billed Grebes (*Podilymbus podiceps*), of which no more than 4 were present at any one time, were watched on a small pond in Seneca, Maryland, from approximately 8 to 9 a.m. on successive week ends from March 22 to April 19, 1953. Activity suggestive of courtship was first noted on March 28 when 2 grebes swam together for a few moments with bills touching, one making a loud, rapid note *h'n, h'n* resembling a nasal laugh. On the following day 2 grebes made the same noise as they swam near each other. On April 5, one grebe (A) suddenly flew over to a second (B). Then B swam after A, remaining 2 to 6 feet behind. Grebe A kept turning its head from side to side as it swam away. The pursuit, which was not hurried, continued for about 30 feet. This same performance of one grebe flying to another, then swimming away with head turning, was observed 3 times in one hour. On April 12 a single grebe (C) remained in one spot and fairly motionless for some time. Suddenly it stood upright on the surface, beating its wings rapidly, and treading water with both feet. In spite of this vigorous and sustained activity the bird remained in one spot. Another grebe (D) was 20 feet away at the time and began to swim toward C, which soon ceased performing and swam toward D. As the 2 came together they floated side by side. Grebe D then held its wings out horizontally and beat them in a rather helpless fashion against the water. Grebe C mounted the back of D and both birds sank under the water with much splashing. After a few moments they separated and swam away. By April 25, the grebes had left the pond, on which they have not been known to nest in previous years.

On April 26 continued observations were made in a wooded swamp one mile from the pond. I waded to the middle of this small swamp until I was about 25 feet from 2 grebes which I couldn't see because of bushes. One made *cowp, cowp, cowp* noises interspersed with *ugh* notes suggestive of air being sucked into a defective pump. The other grebe joined in with the *h'n, h'n* notes described above. Suddenly both birds burst into an open stretch of water, one pursuing the other at top speed. The bird I judged to be the male grabbed the female by the nape of the neck with his bill and held on vigorously for the next few minutes. During this time there was much thrashing about, the pair being as much under the water as above and moving about irregularly the whole time. The male hung on so that he was somewhat on the side of the female. When they had separated and returned behind the bushes, I waded through and found an uncompleted nest. This consisted of old bull rush stalks on top of which was a circular layer of mud and plant matter, the whole resting on the submerged end of a log in 3 feet of water. There were no eggs. Grebe feathers floated nearby on the water. A week later the nest had not been added to, although one grebe was calling in the vicinity. No more grebes were seen in the swamp after this time.

Comment: Courtship activities and at least attempted coition may take place among Pied-billed Grebes before they reach their nesting waters. Activities associated with coition may be more abrupt and violent when eventuating in the vicinity of a nest as Glover (1953. *Wilson Bull.*, 65:32–39) has also described. Courtship behavior of Pied-billed Grebes, especially the standing upright on the water and the head turning, shows some resemblances to that described for other species of grebes.—LAWRENCE KILHAM, *8302 Garfield St., Bethesda, Maryland, May 11, 1953.*

Blue Jays feed tent caterpillar pupae to nestlings.—Although it is generally known that American cuckoos (*Coccyzus americanus* and *erythropthalmus*) and Baltimore Orioles (*Icterus galbula*) feed on tent caterpillars (*Malacosoma americana*), there are few references to the important activity of Blue Jays (*Cyanocitta cristata*) in

the control of this pest (see Forbush, 1929, "Birds of Massachusetts, etc.," Part 2, p. 383). In April and May, one pair of Blue Jays will destroy hundreds of the cocoons to feed the pupae to their nestlings, thus eliminating potential thousands of eggs due to hatch on fruit trees the following spring.

I first observed Blue Jays gathering the cocoons in 1948 while watching a jay nest near my house. As the food brought to the nestlings was always carried inside the mouth instead of between the mandibles, it was necessary to watch the adults as they foraged to find out what they were bringing to the nest. With binoculars, I could see them carry a small white object to a brush pile, hold it between the toes, and pound it with the bill. Something was then tossed into the mouth as the white object was released to float off in the breeze or cling to the twigs. After two or three repetitions of this performance, the parent jay flew to the nest to feed the young. Examining the white objects, I found them to be the silky cocoons woven by the adult tent caterpillar. The birds had opened each one at the end to extract the developing pupa.

Each year since, I have noted that Blue Jays hunt these cocoons about the wild cherry trees.—AMELIA R. LASKEY, *1521 Graybar Lane, Nashville 12, Tennessee, July 22, 1953.*

The cause of partial albinism in a Great-tailed Grackle.—The presence of white feathers in certain areas, on a bird normally colored elsewhere, is a common and well-known phenomenon. The frequency of partial albinism (if we may really apply the term "albinism" here), usually very low, varies with the species; it is highest in the young of the Cliff Swallow (*Petrochelidon pyrrhonota*), but is also rather high in the Robin (*Turdus migratorius*), English Sparrow (*Passer domesticus*), and Brewer's Blackbird (*Euphagus cyanocephalus*). On the other hand, it is very low in such groups as the flycatchers (Tyrannidae), warblers (Parulidae), and the cardueline finches. But despite its widespread occurrence, we know little about the causes of partial albinism.

On November 26, 1952, a female Great-tailed Grackle (*Cassidix mexicanus*) was collected in some newly cleared fields between Las Varas and the Boca de Chila, on the coast of southwestern Nayarit, México. On picking it up, I found that it was white on the left side of the face in the lores, the rear of the malar area, and most of the intervening subocular region. On skinning the bird, thirty hours or more later, I found a large yellow cyst directly under the skin at the same point, in the muscular area beside the rear of the lower jaw. The bird's health was evidently unaffected, as it weighed 121.8 grams even though without fat (which condition is not unusual at this season).

The only preservative at hand was 70% alcohol. Nevertheless, the tissue was preserved and, through the kindness of Dr. Louise Micklewright of the University of Arizona, was prepared for sectioning. She found, however, that it would not slice properly because of a very hard sliver in the center. She then cut some sections by hand and stained them. Nowhere in the preparation are any cell nuclei visible. Thus it appears that the sliver had become accidentally embedded in the jaw muscles, and a very hard fibrous cyst had then developed around it.

These results fall short of what might be desired; but they do suggest that our knowledge of partial albinism might be advanced if collectors made a point of preserving the tissues lying directly under the affected areas. Some abnormalities may not be so obvious, macroscopically, as was this one. It must be admitted that I, for one, have neglected opportunities of this sort in the past.—ALLAN R. PHILLIPS, *Museum of Northern Arizona, Flagstaff, Arizona, July 17, 1953 (Contribution No. 203).*

Notes on the nesting of the Cayenne Swift in Surinam.—The nest of the Cayenne Swift (*Panyptila cayennensis*) is one of the most remarkable structures built by any bird in tropical South America. Although the nest has been known for some time, I am not aware of the existence of satisfactory photographs showing a nest *in situ*. The picture published by the Penard brothers (1910. "De Vogels van Guyana," Paramaribo. Vol. 2:96–97) was long a mystery to me, until I found that it not only

FIG. 1. A nest of *Panyptila cayennensis* under the eave of a roof. Photographed in Surinam on March 9, 1947, by F. Haverschmidt.

shows a nest which is cut open but that the picture is reproduced upside down! I have no detailed observations on the bird's breeding behavior because watching an occupied nest yields no result other than seeing the bird dash out of the nest to vanish altogether. Even so, it seems worthwhile to publish the data I was able to assemble.

The best description of the nest is that by Belcher and Smooker (1936. *Ibis*, 13th Ser., 6:28): "The nest is a tubular sleeve-like structure of plant down collected on the wing, often reaching a length of 2 feet. The sleeve is open at the bottom, where the bird enters and flies up to the egg-chamber, a little saucer shaped pocket some way

up at one side." I did not find corroborated by other writers the statement of these authors that each time the nest is enlarged a new nest cup is made, so that a long used nest may have as many as four cups, one above the other.

The nest is fawn colored and, when cut open and flattened, looks like a tightly woven carpet, about 8 mm. thick, of very soft, downy, plant material. Sick (1947. *Rev. Brasil Biol.*, 7:219–246) gives a detailed description of four nests from Brazil

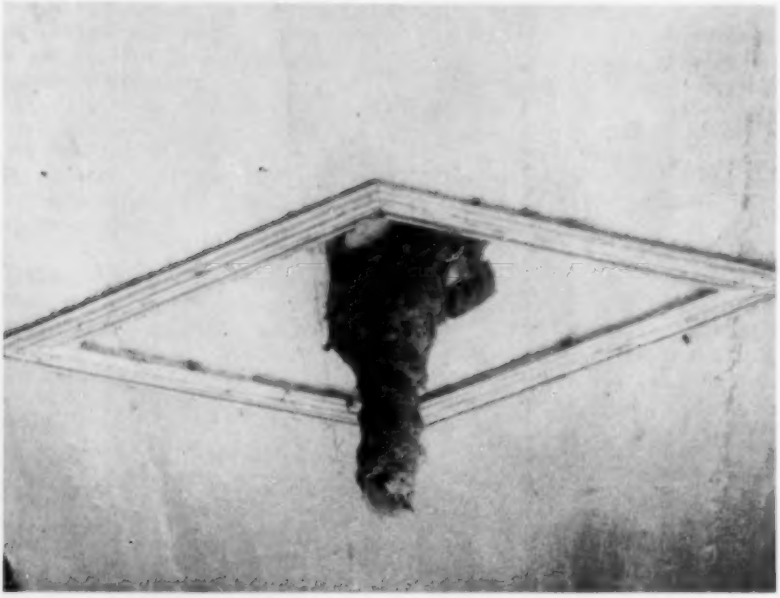

FIG. 2. A nest of *Panyptila cayennensis* hanging from the ceiling of a porch in Paramaribo, Surinam. Photographed on May 10, 1953, by F. Haverschmidt.

with measurements and a careful analysis of the plant material of which these nests were built, but he overlooked the important notes by Belcher and Smooker (*op. cit.*) and Greenway (1934. *Auk*, 51:377–379).

Sick distinguishes two general types of nests, the long, straight type and the short, kinked type.

The nests I found in Surinam were built under the eaves of the roofs of wooden buildings, on the ceiling of a porch of a building, alongside the trunk of a tree, and attached to the underside of a branch. Greenway (*op. cit.*) even mentions nests built inside buildings in the Panama Canal Zone.

Descriptions of the five nests I have found in Surinam follow:

1. March 2, 1947, nest with a very long sleeve under the eave of the roof of the hospital building at the plantation "Peperpot" along the Surinam River (fig. 1). On March 9, the bird was seen leaving the nest; it was again observed dashing out of the nest on April 11 and June 27, 1947. In 1948 the nest was enlarged and occupied

again; the bird was seen leaving the nest on May 23. In 1949 the nest was once more enlarged and inhabited; I saw a swift flying out of it on June 9. This nest was the largest of all I have seen.

2. On March 23, 1947, I found a second nest on this plantation. It was built alongside the trunk of a shade tree (*Erythrina glauca*) at a height of about 20 meters. The nest appeared old and not in use at that time.

3. On April 4, 1948, I found a nest suspended from the underside of a horizontal branch of a huge cotton tree (*Ceiba pentandra*), about midway out from the trunk, at a height of about 30 meters on the plantation "La Liberté" along the Surinam River. The bird was not seen but the nest looked new. This nest seemed remarkable to me as it was attached to the branch only at the top, while the sleeve hung free in the air.

4. On April 3, 1951, I found a nest with a long sleeve under the eave of the roof of a building on the grounds of the waterworks at Republiek. The nest was occupied at that time as the bird was seen repeatedly leaving the nest. On August 13, 1952, the nest was still there and apparently it had been used again though the bird was not seen. In this same locality on April 6, 1951, I found a different nest on the ground which had apparently been removed from its site. This nest was of the kinked type with only a short sleeve.

5. On April 9, 1953, I found a nest with a long sleeve hanging from the ceiling of a porch of a building along the Surinam River in the middle of the town of Paramaribo. It was of the same type as nest 3, as its upperside was attached to the roof and the sleeve hung freely in the air (fig. 2). Although I did not see the bird, the nest was inhabited, since on the floor under it lay some fresh excrement.

From these notes it seems clear that in Surinam the nests are occupied from March to the end of June, which is corroborated by the observations of Belcher and Smooker (1936) in Trinidad who found nests occupied usually in April. Because of the inaccessibility of the nests, I never was able to examine their contents. The nest of a near relative, *Panyptila sancti-hieronymi*, which occurs in western Guatemala and which is considered by Peters (1940. "Check-List of Birds of the World," Cambridge. Vol. 4:253-254) as a separate species but by Stresemann (1927-34, "Aves. Handbuch der Zoologie." Berlin. p. 348) as only a geographic race of *cayennensis*, is described as similar but is said to contain a "false entrance" half way up its side (Sclater 1863, quoted by Stresemann, *op. cit.*). Whether this is the rule or only an exception further observations must show.—F. Haverschmidt, *P. O. Box 644, Paramaribo, Surinam, Dutch Guiana, May 18, 1953.*

Two Mallard ducks caring for the same brood.—On July 5, 1953, a Mallard duck (*Anas platyrhynchos*) hatched a late brood of four young on Wintergreen Lake at the W. K. Kellogg Bird Sanctuary. The following day one duckling disappeared and on July 8 only two remained. However, on this date two Mallard ducks were noted for the first time to be with the young and from that time on the two ducks were seen always with the two young. Both females seemed equally concerned over the care of the young and all four birds kept in close proximity to one another. On July 10, a particularly aggressive male Mute Swan (*Cygnus olor*) was observed swimming rapidly towards the young ducklings. The two ducks were unsuccessful in their attempts to herd the ducklings away from the onrushing swan. As the swan reached out to seize one of the ducklings both of the Mallard females flew at the head of the swan. For several minutes both ducks continued their attack on the swan, beating him about the head and neck with their wings. The swan soon retreated and the Mallards returned

to the two ducklings. At the present time (July 17) only one duckling is left and both ducks are caring for it.

The Mallards at the Sanctuary are wild birds that have become tame; they are full winged and free to come and go as they please. Every year a score or more Mallards nest along the shores of the Sanctuary lake and it is with one of these late broods that the above observations were made. I was unable to ascertain which Mallard was the actual parent.—ARTHUR E. STAEBLER, *W. K. Kellogg Bird Sanctuary of Michigan State College, Hickory Corners, Michigan, July 17, 1953.*

Robins eating minnows.—Robins (*Turdus migratorius*) are seldom thought of as fish eaters, although observations of Robins eating trout fry have been reported by Phillips (1927. *Bird-Lore*, 29:342–343) in Massachusetts and by Michael (1934. *Condor*, 36:33–34) in California.

I witnessed another type of this unusual feeding habit by a pair of Robins in the city of Sturgeon Bay, Door County, Wisconsin, on May 31, 1953. Scattered about a dock on the shore of Sturgeon Bay were many dead emerald shiners (*Notropis atherinoides*) discarded by fishermen. This abundant species is commonly called "lake shiner" by anglers and is much favored as a bait minnow in Lake Michigan and Green Bay waters.

Two Robins, possibly a mated pair, were seen foraging around the dock for a period of about ten minutes before being frightened off by the arrival of several fishermen. In this interval one of the birds twice picked up two dead minnows about 1½ inches long and flew off holding the fish crosswise in its bill, shortly to reappear without them. I was not able to see the destination of this bird's flight. It is possible that the minnows were being fed to nestlings.

The second Robin was observed to pick up and swallow four dead minnows, also about 1½ inches in length. Each fish was picked up crosswise and juggled in the bird's bill until it could be swallowed head first. All four fish were handled with some dexterity, as if the Robin had fed in this manner before.

The minnows eaten by these Robins had been dead long enough to be dry on the surface, but the flesh was still soft.—JAMES B. HALE, *405 Washburn Place, Madison 3, Wisconsin, July 6, 1953.*

Reddish Egret and White Pelicans in northwestern Pennsylvania.—In the afternoon of May 9, 1953, a Reddish Egret (*Dichromanassa rufescens*) in the dark phase was seen on Presque Isle, located near Erie, Pennsylvania. The bird was identified by Stanley Belfore, Mary Templin, Margaret Band, Mr. and Mrs. Charles Shontz, and John Mehner, all of Pittsburgh, Pennsylvania, Robert Sundell of Frewsburg, New York, and Mr. and Mrs. H. C. Pees of Meadville, Pennsylvania.

The egret was seen in excellent light, through a 26 power telescope. It was observed feeding for a half hour near a sand spit at the eastern tip of the peninsula, and its characteristic behavior was noted. As it fed, the egret lurched about and ran in circles. Later it flew over the spit to a stump in the water where it was once again observed with the scope. This constitutes the first record of this bird in northwestern Pennsylvania.

A few minutes after the egret was found, two White Pelicans (*Pelecanus erythrorhynchos*) were observed in flight over the sand spit. Herring Gulls (*Larus argentatus*), Ring-billed Gulls (*Larus delawarensis*), and Caspian Terns (*Hydroprogne caspia*), which were perched on the spit, immediately flew into the air, giving call notes. The

gulls and terns circled the area for approximately fifteen minutes, the majority coming back to the water instead of the sand. Later the pelicans alighted on the sandspit, and when they were last observed the gulls and terns were also on the spit. On the basis of information from George B. Sennett, Warren (1890. "Report on the Birds of Pennsylvania," pp. 29–30) writes that White Pelicans were seen in the vicinity of Erie between 1870 and 1875. Todd (1940. "Birds of Western Pennsylvania," p. 44) cites four other records for this bird in western Pennsylvania.—JOHN F. MEHNER, *1003 James Street, Pittsburgh 34, Pennsylvania, May 16, 1593.*

Incubation period of the Mourning Warbler.—There are apparently few records of the incubation period of *Oporornis philadelphia*. Bent (1953. *U.S. Natl. Mus. Bull.* 203) does not give any information about the incubation period nor about the time spent in the nest by the young of this warbler. Therefore, the following notes seem worthy of record.

On June 12, 1951, I flushed a female Mourning Warbler from her nest. The nest, containing three eggs, was located in a *Populus-Alnus* swamp within the city limits of Duluth, Minnesota. It was placed on the ground in a drier portion of the swamp, and was well hidden by wild strawberry plants. On June 13 a fourth egg was added. On June 23 the female was still incubating the four eggs. I was unable to visit the nest again until June 28 at which time I found the four eggs had hatched. I estimated the age of the young to be about four days, based on a comparison of their development with that of the Yellow-throat (*Geothlypis trichas*). The young left this nest on July 2.

The second nest was found on July 1, 1953, in a windfall clearing on the grounds of the University of Minnesota Forestry and Biological Station at Itasca State Park. The nest was placed 14 inches above the ground, and was supported mainly by a swamp thistle (*Cirsium muticum*). At the time the nest was found it was empty. On the morning of July 3 the nest contained two eggs, and by 9:00 a.m. on July 4 a third egg was added. The nest was visited daily, and on July 16 all three eggs had hatched. I left Itasca Park on July 18, but Dr. William H. Marshall, of the University of Minnesota, provided me with further information on this nest. He visited the nest on July 23 and again on July 26. On July 23 the nest contained three well-developed young, but on July 26 the nest was empty. It was Dr. Marshall's opinion that the young had successfully left the nest, probably before July 26.

The observed incubation period for the second nest and the estimated period for the first nest indicate an incubation period of 12 days. The young apparently leave the nest at an age of eight or nine days.—P. B. HOFSLUND, *Biology Department, University of Minnesota, Duluth Branch, Duluth, Minnesota, August 12, 1953.*

An unusually high nest of the Yellow Warbler.—On June 6, 1953, Geza Hufnagel, Harold Mahan, Walter P. Nickell, and I made observations on the nesting birds at Rondeau Park, Kent County, Ontario. The habitat in the area studied is an extensive climax forest of beech (*Fagus grandifolia*) and sugar maple (*Acer accharum*) with an admixture of red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), red oak (*Quercus rubra*), and other deciduous trees. The predominant undershrubs are American hornbeam (*Ostra virginiana*), spicebush (*Lindera benzoin*), sassafras (*Sassafras albidum*), and raspberry (*Rubus*). These and other shrubs together with wild grape (*Vitis* sp.) and an abundant growth of beech and maple saplings form a dense understory.

The Yellow Warbler (*Dendroica petechia*) nests abundantly in this understory association. Of 25 nests of the Yellow Warbler found on June 6, all but one were in this type of habitat, and were located at heights of from 21 inches to 12 feet. The exception was in an upright fork, almost at the top of an American beech. The female warbler flew from the nest when we tapped the trunk of the tree. The nest contained 5 eggs. A weighted line dropped from the rim of the nest to the ground measured 39 feet with a steel tape.

A. C. Bent (1953. *U. S. Natl. Mus. Bull.* 203, p. 163) gives the usual heights for nests of this species as from 3 to 8 feet, rarely to 30 or 40 feet. However, he cites (p. 164) nests recorded by T. S. Roberts at heights of 40 to 60 feet in cottonwoods in the prairie region of Minnesota, where shrubbery is scarce. The highest nest that Bent mentions from eastern North America (p. 167) was 30 feet up in an elm, recorded by T. E. McMullen in either Pennsylvania or New Jersey (no date).—Douglas S. Middleton, *7443 Buhr, Detroit 12, Michigan, August 15, 1953.*

Cannibalism by a Burrowing Owl.—While visiting a large prairie dog "town" situated 4½ miles north and 2 miles east of Sharon, Barber County, Kansas, on the afternoon of May 6, 1953, I observed four Burrowing Owls (*Speotyto cunicularia*). Three were perched on mounds of earth thrown up by prairie dogs at the entrances to their burrows. The fourth owl was observed feeding between two of these mounds. I approached the feeding owl and flushed it from a dead Burrowing Owl. Feathers from the breast and belly of the dead owl were scattered about in the short grass. The head had been torn from the body and could not be found. There remained the skin of the body with the wings and legs attached. The kill seemed to be no more than a day old; the exposed edges of the skin were dry and friable, and there were dried drops of blood on the feathers. Another instance of cannibalism by a Burrowing Owl has been reported by Bent (1938. *U. S. Natl. Mus. Bull.*, 170:390).—Thane S. Robinson, *Museum of Natural History, University of Kansas, Lawrence, May 19, 1953.*

Western records of *Chaetura vauxi tamaulipensis*.—As recently as 1939 it was generally supposed that the distribution of the swifts of the genus *Chaetura* in North America, north of Tamaulipas, was very simple: *vauxi* in the western part of the continent, *pelagica* in the eastern, and casually west over the Atlantic drainage as far as New Mexico. The only problem thought worthy of study was the winter range of the latter, then unknown. Swifts being in most places notoriously difficult to collect, the "sight record," based on geographic "reasoning," held happy and unchallenged sway.

The first shock to this complacency came when Lowery (1939. *Wilson Bull.*, 51: 199–201) discovered that a few swifts occasionally winter in Louisiana, and that they are *vauxi* rather than *pelagica*! We still, however, lack records of *vauxi* in any other region near Baton Rouge, so perhaps the shock failed to open closed minds. Soon afterward, Sutton (1941. *Wilson Bull.*, 53:231–233) demonstrated the intermediate characters of the birds of northeastern Mexico, which he named *C. v. tamaulipensis*, and showed that they are at least partially migratory. The only record between October and March, apparently, was one from San Lucas in the mountain of southern Guatemala. With the announcement by Barnes (1946. *Auk*, 63:258) of the capture of *C. pelagica* in Utah, and the discovery of its winter home, it seemed likely that the next important discoveries would be in the northern or western parts of the Mexican mainland or the adjacent Southwest of the United States. Here, west of Tamaulipas and San Luis Potosí, *Chaetura* was

generally an uncommon transient, a status not conducive to procuring specimens of such masters of the air!

The past few years seemed unfavorable for *Chaetura* in southeastern Arizona; few were seen, and no *C. v. vauxi* were taken. On May 14, 1950, however, I was fortunate enough to secure a lone male swift feeding with about fifty Violet-green Swallows (*Tachycineta thalassina*) rather low over the grassland at the mouth of Garden Canyon on the Fort Huachuca Reservation, Cochise County, Arizona. Subsequent examination by several ornithologists showed this to represent some Mexican race. Only Dr. Sutton, however, had enough material to actually compare it with *tamaulipensis*. He has kindly written me, under date of January 15, 1953, that it is "very similar" to the type and three topotypes (two males, one female) of *tamaulipensis*, "but rump feathers and upper tail-coverts . . . somewhat more conspicuously edged with buffy gray; and lower belly and under tail-coverts very slightly darker. General effect of the crown and back very similar to that of male topotypes—*i.e.*, less blackish than in *richmondi*." Summarizing, he writes: "I see no reason why the bird should not be called *tamaulipensis*. . . . I cannot believe that the nominate race is ever this dark on the crown, back, lower belly, and under tail-coverts."

Meanwhile, I was very much interested to find a number of *Chaetura* apparently settled for the winter in the foothills east of Las Varas, southwestern Nayarit, in mid-November 1952. They never came within range more than momentarily at my camp at the foot of the mountains; but in returning up to Compostela on November 29, I found them hawking low over the cornfields along the road just above Mazatán. In fact, a Rough-winged Swallow (*Stelgidopteryx ruficollis*) that pursued one too hotly was killed instantly in full flight by striking telephone wires. Climbing a little ridge in the sloping fields in this narrow valley, I obtained a single female just finishing the annual molt. Though a trifle paler, this closely resembles the Arizona male, and it doubtless represents the same race. Both are definitely distinct from *C. v. vauxi*, according to the studies of Allan J. Duvall and Dr. Alexander Wetmore. I wish to thank all of those who have helped in the identification of these swifts.

Thus it appears that any of the three northern forms of *Chaetura* may turn up almost anywhere on the Mexican mainland or in the adjacent parts of the United States. *Chaetura* thus joins the large and growing list of genera in which, to have any scientific value whatever, records in this large region must be based on critically determined specimens. Further, the north Mexican race may now be added to the American Ornithologists' Union Check-List of North American Birds as having been recorded from southeastern Arizona.—Allan R. Phillips, *Museum of Northern Arizona, Flagstaff, Arizona, August 21, 1953.*

SEVENTY-FIRST MEETING OF A.O.U.

At the meeting of the American Ornithologists' Union in Los Angeles in October, the following officers were elected for 1953–1954: *President*, Alden H. Miller; *Vice-Presidents*, Ludlow Griscom and Ernst Mayr; *Secretary*, Harold Mayfield; *Treasurer*, Charles G. Sibley. *Elective Members of the Council*: John T. Emlen, Jr., A. W. Schorger, Albert Wolfson.

The Council re-elected Robert W. Storer, *Editor* of 'The Auk'; Frederick V. Hebard (Chairman), G. Ruhland Rebmann, Jr., and Phillips B. Street, *Investing Trustees*.

The 1953 Brewster Medal was awarded by action of the Council to Dr. Hildegarde Howard for her research on fossil birds.

The following were elected to the class indicated: Fellows: W. Lee Chambers, John Roy Pemberton, Francis Marion Weston. Honorary Fellow: Ernst Schuz. Corresponding Fellows: Edward M. Nicholson, Ludwig Schuster. Members: Paul Herbert Baldwin, Frederick Milton Baumgartner, Alexander William Blain, John Davis, Miguel Alvarez del Toro, Keith Lee Dixon, Henry Sheldon Fitch, Gordon W. Gullion, Thomas Raymond Howell, Carl Buckingham Koford, Robert Allen Norris, Kenneth Carroll Parkes, Kenneth E. Stager.

Albert Wolfson

LETTER TO THE EDITOR

So many requests for information as to the status of Peters' "Check-List of Birds of the World" have come to the Museum of Comparative Zoology that we think your readers would be interested in the matter.

We have been appointed joint editors to see that the work is completed. Probably seven volumes will be required to contain the families not treated by Mr. Peters. A volume has almost been finished by Dr. Zimmer of the American Museum in New York. Sixteen collaborators have most kindly agreed to contribute the families that remain to be done and each one will be the responsible author of his contribution. We hope by this means to assure that the work will be completed in as short a time as possible.

Ernst Mayr
James C. Greenway, Jr.
Museum of Comparative Zoology at Harvard College

DISTRIBUTION OF MEMBERSHIP

A study of the membership roll as published in the December, 1952, *Wilson Bulletin*, produced some interesting data regarding the distribution of our membership. While our roots are in the midwest, the present composition of the membership shows that we are today much more national in scope than one familiar only with the early days of the organization might realize. The membership includes persons from every state, most Canadian provinces, and many foreign countries. New York showed the greatest membership, 174, followed by Michigan, 143, Ohio, 131, Illinois, 82, California, 78, Pennsylvania, 73, Wisconsin, 70, Minnesota, 67, Massachusetts, 55, and Iowa, tenth with 45. The second ten showed New Jersey and Texas tied with 43, Indiana, 41, Maryland, 39, Kentucky and Missouri tied with 43, Kansas, 31, West Virginia, 30, and the District of Columbia and Ontario tied with 29. A line drawn through Columbus, Ohio, to the Gulf of Mexico east of Tallahassee, Florida, approximates the actual dividing line of the eastern and western halves of our membership.

ORNITHOLOGICAL LITERATURE

THE CALIFORNIA CONDOR. By Carl B. Koford. National Audubon Society, New York, 1953: 7⅞ × 10½ in., xiii + 154 pp., 31 pls., 15 text-figs. $3.00.

This is a most thorough report upon the history, distribution, population, mechanics of flight, and behavior of the magnificent bird based upon experience gained in nearly 500 days spent by the author watching condors. His work in the rugged terrain occupied by condors was facilitated by his ruggedness as a mountaineer. His sponsors in the National Audubon Society and the Museum of Vertebrate Zoology of the University of California, realized the necessity for so detailed a life history study as a basis for understanding how best to assist the condor in maintaining its numbers. For the condor is affected deeply by the activities of man, consequently it is up to man to regulate these activities appropriately—assuming of course that we all want the condor with us. It is a surprise to learn that some do not; an article has actually appeared entitled "What price condor?" and there have been various attempts to sacrifice the bird's welfare to exploitation of minerals in its roosting and nesting areas.

A model of tactful writing, the book avoids caustic comments upon human foibles and so may win more to the condor's side. The author's heaviest sarcasm (regarding oil development) is mild indeed: "most of the interest has been in buying and selling leases rather than in drilling and production." Reading between the lines we find as profound a study of man as is ever likely to come out in an ornithological publication. By his own example Dr. Koford has demonstrated the feasibility of his suggested program of conservation by education, through personal contact, of those persons who meet the condor in their daily lives.

The reader must appreciate that variability in the condor's behavior necessitates the detail presented by Dr. Koford; many aspects of its activity do not resolve themselves into the clear-cut patterns we find in studies of more stereotyped species. The reviewer has watched the growth of this condor project over the years in seminars, a visit to the condors with Dr. Koford, informal discussions, and in the author's papers presented at scientific meetings. As the study matured, as the facts piled up (3500 pages of field notes!), generalities had to be abandoned. With 10 days of observations upon the condor a neat simple picture of its behavior could easily be portrayed. With 500 days the exceptions literally become the rule. It is purely the personal opinion of the reviewer that we see emerging from this wealth of information the one constant trait of the condor which is precisely its *inconstancy*; it is erratic, cautious, unpredictable and capricious. The condors roost a few days or weeks at one place. Then they move. A pair nests and years go by before the site is again used. The birds feed at a carcass one day and may never return; some carcasses are consumed, others in favorable locations are ignored. This constant shift, feint, and deployment, though occurring within one general mountainous area, might insure that the population as a whole will not suffer from a local catastrophe.

The approximately stable, total population of condors is about 60 individuals; therefore the prevention of the death of a single condor or of the failure of a single nest may mean that the population will show an increase rather than a decrease for a given year. Artificial provision of carcasses is impractical because the condor is so erratic in its selection of food. Rather, it is best to facilitate utilization of available carcasses (should they be free of disease) by not destroying them and where possible by dragging them to openings. The protection of former nest sites is justified because

of the tendency of the birds to use them again after many years. Extreme alarm, rather than tameness, prompts the condor to come near a human at the nest. "One man can keep a pair of condors from the egg all night or prevent the feeding of a chick for an entire day merely by exposing himself within 500 yards of a nest for a few minutes at one or two critical times of the day. Loud noises can alarm condors at distances of over one mile." The apparent success of a nest near a logging road in Tulare County was due to a fortunate series of coincidences which kept disturbance at a minimum and does not constitute evidence that nests would ordinarily succeed in such circumstances. Practically every phase of condor activity has been adequately photographed in color, both in motion pictures and stills, and since it is impossible to photograph the nesting birds without disturbing them there is no justification for further photography in any portion of the nest-roost-water area.

Sensational and false information about the condor frequently appears in the popular press. This prompts curious folk to seek out and disturb the bird. It is not enough to make available reliable information—it must be watched for distortions clear through the stages of publication.

Condors are especially cautious at their chosen nesting sites, roosts, and drinking and bathing places. Since they require very limited conditions of terrain for flight and feeding, and because of the enormously long fledging period, year-round freedom from disturbance in the limited area meeting their requirements is necessary. Fortunately this area is relatively inaccessible to man. As long as no more roads and trails are constructed near roosts and nests the outlook for the condor is good.

By far the most effective means of conservation is through education by personal contact, for the condors will not stay in a sanctuary. One man truly interested in condors can secure the cooperation of ranchers upon whose property the birds feed, of fire lookouts, trappers, forest rangers, game wardens, etc.,—a select group of persons who naturally come in contact with the birds and who have the opportunity to pass on the information. "The interest and cooperation of these people can best be gained by helping them to understand something of the relation of the condor to its environment rather than by giving them a list of 'don'ts.' . . . If eventually it is possible to employ permanently a man to guard the interests of condors in the field, this man should spend much more time visiting persons throughout the condor range and securing their cooperation than in patrolling nesting areas against intruders. With education and cooperation, little, if any, patrolling probably would be necessary."

The condor is *not doomed to extinction.* Ever since 1890 writers have portrayed it as a relic of the Pleistocene with "one wing in the grave," in spite of which the great bird has persisted to this day and has even extended its breeding range into Tulare County. True enough, its breeding range has receded in historic times from San Diego County and along the coast from Monterey to San Luis Obispo counties; but this is far less severe than the impression of wholesale decimation one gets from incorrectly considering the former range as extending from the Columbia River to the San Pedro Martir Mountains of Baja California. There is no evidence that the birds at these far-flung outposts were breeding. Evidently they had gone there for particular food supplies, possibly salmon in the case of the Columbia River. "Inasmuch as the condor has persisted in spite of apathy and predictions of its early extinction, let us be optimistic and assume that the species will persist indefinitely if we give it aid." It seems to the reviewer that it is the duty of every ornithologist not only to read Dr. Koford's book but to insure that his recommendations for aid are actually carried out.—Joe T. Marshall, Jr.

THE FULMAR. By James Fisher. Collins, St. James's Place, London, 1952: 5¾ × 8½ in., xv + 496 pp., frontis. (painting by Peter Scott), 82 photos (4 colored), 70 maps, diagrams, and line-drawings. Distributed in the U.S.A. by John De Graff, Inc., N.Y. $8.00.

Examples of species which are expanding their ranges are not numerous, and studies of the dynamics of such range expansions are rarer still. We have James Fisher to thank for what is probably the most thorough such account prepared to date. In many ways Fisher's choice of a subject was fortunate: Fulmars were an important source of food to the inhabitants of islands where they nest, arctic explorers have contributed many observations on the species, and the Fulmar has been the subject of special cooperative studies by the British Trust for Ornithology. The scope of the research which went into the preparation of this book is perhaps best expressed by stating that 2,378 works were consulted, and unpublished material was obtained from 575 persons. (A copy of this bibliography has been filed with the Society for the Bibliography of Natural History.)

Following two chapters introducing the Fulmar and its relatives, the Antarctic and Pacific fulmars, are eight chapters which take up nearly half of the book and recount the history and spread of the Fulmar in the Arctic, Iceland, Faeroe Islands, Norway, St. Kilda, and Britain. Two chapters are devoted to the populations of the Fulmar and the geographic distribution of its color phases. Next are a series of chapters on the life history of the Fulmar, including accounts of the Fulmar at sea, its voice and display, yearly cycle, parasites and enemies, and food. The final chapters treat the possible causes of the Fulmar's spread and the question of how often the Fulmar breeds. A very short bibliography, an appendix, and an index complete the work.

The numerous illustrations are both attractive and well integrated with the text. They include a handsome frontispiece by Peter Scott; over eighty photographs, including many striking pictures of the cliffs on which the Fulmars nest and of the birds themselves; and a wealth of maps, graphs, and line drawings. Of particular value are several photographs showing some of the displays of the Fulmar.

One of Fisher's major contributions is in pointing out numerous problems which merit further study. A comprehensive study of the relationship between colony size and nesting success, in particular, would be valuable. Many of the calls and displays of the Fulmar have been described, but much remains to be learned about their significance. What determines the distribution of the dark and light phases of the bird is not clear. A close check on future changes in population size should be kept and, finally, an attempt to find out the reasons for the bird's spread should be made. Indeed, the groundwork has been laid for what could be a magnificent life history study.

A few parts of the book are not up to the standards of excellence of most of it. The measurements of Fulmars (Appendix III) were compiled from some fifteen references; it is always unwise to average measurements made by different workers. This is particularly true when, as seems to be the case here, wing lengths taken by Europeans, who measure the arc, and those taken by Americans, who usually measure the chord, are combined. The index contains two parts: a list of the vertebrates mentioned (in a systematic order) and a list of selected places. The lack of a more complete subject index hampers the reader who wants to look up an aspect of the Fulmar's life history. Finally, while it is understandable that the complete bibliography could not have been included, it is annoying to find works cited merely as "W. Stone (1892)" with no further clue as to where to find them without writing to the Society for the Bibliography of Natural History, the address of which, incidentally, is omitted from the book.

These defects, however, detract little from the great value of the work; the author and the other editors of the New Naturalist Series are to be congratulated on having produced an excellent book.—Robert W. Storer.

The Birds of New Brunswick. By W. Austin Squires. Publ. New Brunswick Museum. Monographic Series No. 4. Saint John, 1952: 6 × 9¼ in., title + 164 pp., index, 12 photos., map (folding).

Ornithologists are still few and far between in New Brunswick. Nevertheless, there has been a handful of avid observers in various parts of the Province and a steady stream of visitors to fascinating and ornithologically fruitful Grand Manan Island at the mouth of the Bay of Fundy. There has been no systematic general collecting in the Province. As a consequence of these factors, the list of casuals and accidentals is formidable, but subspecific determinations for common species are few.

In this list much new material has been added and a widely scattered literature has been brought together. The old lists have been sifted, and many dubious records have been rejected. However, many species admitted to the present list on the strength of sight records should probably be relegated to a hypothetical status.

New Brunswick birdlife presents a full quota of oddities. Both Richardson's Boreal Owl and the Brown Thrasher are breeding birds in the Province. Turkey and Black vultures, both casual, are equally numerous. Purple and Florida gallinules have been recorded with equal frequency as accidentals. Although Bald Eagles are numerous in summer, nests are rare. Banding has proved that most of the summer population is made up of post-breeding wanderers of the southern race (*H. l. leucocephalus*) from as far south as Florida, while eagles nesting in New Brunswick are of the northern race (*H. l. washingtonii*). The climate at the mouth of the Bay of Fundy is much colder in summer than that of the Gulf of St. Lawrence coast to the northeast. Thus, many of the most typically northern birds are found breeding in the southern portion of the Province rather than in the north.

As the first modern annotated list of the birds of New Brunswick this publication will find a welcome place on many ornithological bookshelves.—C. O. Handley, Jr.

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SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A. O. U. Check-List (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

NOTICE OF CHANGE OF ADDRESS

If your address changes, notify the Club immediately. Send your complete new address to the Treasurer, Leonard C. Brecher, 1900 Spring Drive, Louisville 5, Kentucky. He in turn will notify the publisher and editor.

THIRTY-FIFTH ANNUAL MEETING

of the

WILSON ORNITHOLOGICAL CLUB

CAPE MAY, NEW JERSEY

FRIDAY, JUNE 11, TO MONDAY, JUNE 14

Sponsored by

Delaware Valley Ornithological Club

Urner Ornithological Club

New Jersey Audubon Society

Plan now to attend this eastern seaboard meeting to be held in an area as widely known ornithologically as any in the United States.